Engineering Library

SEP 19 1940

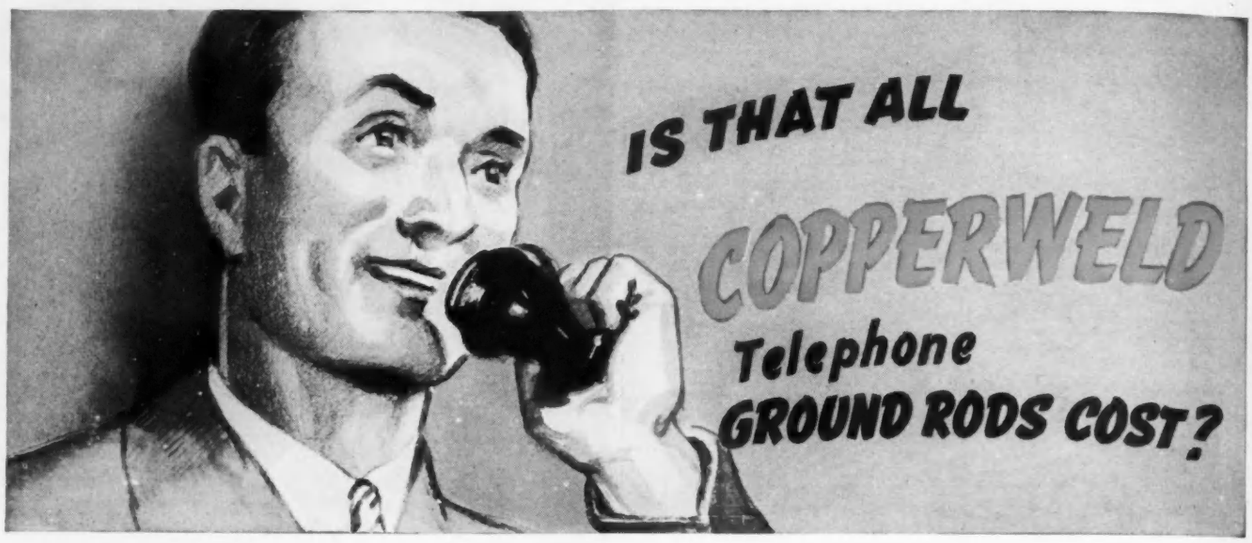
TELEPHONE ENGINEER

The National Telephone Magazine

SEPTEMBER 15, 1940

Estimating Construction Costs...On the News Front...The Longitudinal Circuit...Short Course in Telephone Transmission...Quizzicus Asks Questions...Line & Desk...Long Lines...Sell Telephones

Management *Engineering* *Maintenance*



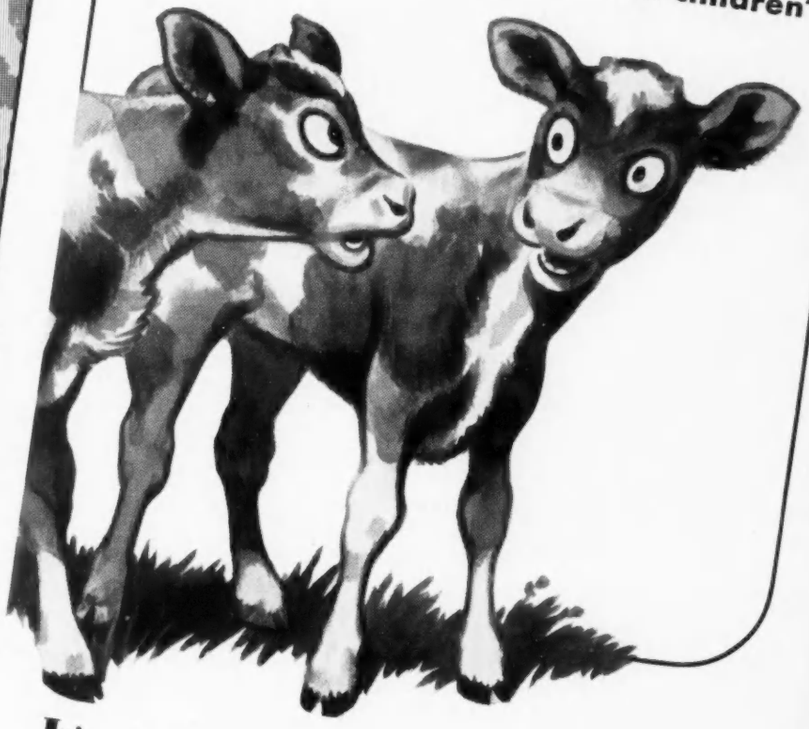
"WHY DOESN'T SOMEONE TELL ME THESE THINGS?...We could have been saving on ground rods and getting better grounds with Copperweld Rods. A non-rusting telephone ground rod for thirty-three cents* is a buy."

*** The price of a ⅜" x 5' Copperweld Telephone Ground Rod with 18" Pigtail of .104" annealed copper is $33.15 per 100 pcs. in quantity of 100 or more, f.o.b. any freight station in Hardware Zone 1. *ASK FOR YOUR COPY OF NEW GROUND ROD DATA SHEET E. D. 1687.***

COPPERWELD STEEL COMPANY · GLASSPORT, PA.

"Wonder why they're stretching
a wire to the schoolhouse"

"For a telephone, silly . . . makes
folks feel safer about their children"



IT'S so convenient to get in touch with some one at the right time at the right place when there's a telephone. Children away at school, father in town, married daughter on the farm nearby—and all of them within easy reach of your voice.

BELL TELEPHONE SYSTEM

ACROSS THE Editor's Desk

From the many announcements coming from the manufacturers we are of the opinion that more exhibitors than ever before will show at the National Convention. These exhibits are very important to the success of the convention and we are glad to report on their plans for those of you that attend this year.

▼

The Association officers have already obtained the services of two outstanding speakers to address you. One of them is mentioned in this issue. We refer to W. J. Cameron who is known to millions over the Sunday Evening Hour radio program. The other, Cornelius Vanderbilt, Jr., has made a reputation as one of the outstanding commentators, world traveler and news hounds you will ever hear. This is the "dessert" arranged for your pleasure. The business sessions will be of more importance than any during the past decade.

▼

The Editor of TELEPHONE ENGINEER is also preparing a treat for its readers. The October Convention Number will be in your hands a week before the National Convention starts. It will give you the official program, a complete story of the meeting you will attend, including what you will see in the exhibits. The advertising pages will be jam-packed with important announcements. Yes Sir, your manufacturers, officers of the Association and TELEPHONE ENGINEER want you to get the fullest benefit of the Convention this year.

TELEPHONE ENGINEER

MANAGEMENT · ENGINEERING · MAINTENANCE

Vol. 44, No. 9 SEPTEMBER 15, 1940

CONTENTS

- Across the Editor's Desk 10
- Estimating Construction Costs By Jay G. Mitchell 14
- On the News Front By Roland C. Davies 15
- Ohio Association Honors Island Company 18
- The Longitudinal Circuit By R. A. Shetzline 19
- Short Course in Telephone Transmission By B. C. Burden 21
- Sell Telephone by Engineering Principles By Atwell Jackson 23
- Quizzicus Asks Questions 24
- Line & Desk—By Ray Blain 28
- Long Lines—By R. A. Clark, Jr. 30
- Station Barometer 32
- 25 Years Ago This Month 45
- A Wiping Solder with Improved Handling Characteristics—By Earl E. Schumacher 50
- Index to Advertisers 58

Published Monthly by

Telephone Engineer Publishing Company

A Magazine devoted to the interests of the entire telephone industry—operating men and manufacturers.

SERVING THE FIVE BILLION DOLLAR TELEPHONE INDUSTRY

Founded in 1909

Office of Publication, Pontiac, Illinois. Executive and Editorial Offices 7720 Sheridan Road, Chicago, Illinois. Phone Rogers Park 3040. J. A. SMITH, President and Treasurer; RAY W. SMITH, Vice-President and Editor. Subscriptions: U. S., Cuba, Mexico, $1.00 Per Year; Canada, $1.50; In all Other Countries, $3.00. Single Copies, U.S.A., 15 cents. All Subscriptions should be sent DIRECT to 7720 Sheridan Rd.

ESTIMATING Construction Costs

By JAY G. MITCHELL

The Author

In this installment the author goes into some of the detail methods of developing system of Estimating Construction Costs. The discussion covers Subdivided Estimates —Unit of plant which cannot be covered by averages— Extreme refinement inadvisable—physical data must be accessible for check—illustration of Labor Relatives— Lost Time—Average Wage Rate Cost.

Subdivided Estimates

DURING the development of the system of labor relatives it will sometimes be found necessary to subdivide estimates covering projects which include extensive and diversified construction into separate work orders subsequent to executive authorization. This is done to make it possible to associate the man hours in each of the several classes of labor with the units of plant with which they are associated. While it is the considered opinion of the author that all estimates submitted for executive consideration should be initially compiled in as great detail as possible, after all it is usually the total cost of new plant and the retirements of displaced plant that are important from the operating executive standpoint. It is very certain that the development of any workable system of labor relatives requires the separation of the final labor and time reports into classes of labor, the associated units of plant and the associated characteristic construction conditions. Since the time reports and completion reports must match up with the estimates to which they apply it is obvious that the estimates themselves must be subdivided into characteristic parts from the construction standpoint. The simple and practical method of doing this is to issue an identifying estimate number, during the period of development of the labor relative data, for each part of each project which calls for definitely characteristic labor conditions.

An imaginary illustration of this idea would be found in the estimate for a thirty foot creosoted yellow pine pole lead extending fifty miles across country, ten miles through level territory where the poles are to be set in sandy loam, ten miles across a rocky valley where the poles are to be set in places where the digging is very difficult and the territory very rough and thirty miles in territory where the soil is hard clay. Such a project would probably be covered by one estimate, a fifty mile cross country pole line, but it would afford the opportunity, by breaking down the approved estimate into three work orders, to obtain from field and time reports an average for each of the man hour requirements for setting poles in three kinds of soil. The same thing is true of estimates covering other units of plant and would involve very little clerical work over and above that required otherwise. The subdivision should not be continued beyond the point at which the labor relatives approach uniformity for each construction condition and could not be effectively criticized except on the comparatively unimportant ground that it introduces a multiplicity of work orders and some additional clerical work.

It may be said in passing that such construction operations as the making of cribs to support poles set in the bed of streams should preferably be made the subject of *separate* and *individual* estimates. This is because such construction is almost sure to be special in each case and *average* figures for the required man hours, the total material or the gross cost can not safely be used unless they are made so high as to cover any set of special conditions that may be encountered. When so fixed they may easily distort the totals and may result in error in the averages for other units of plant which are standard and are covered by the same estimate.

It should be emphasized, however, as a practical matter that the idea of reducing the total labor to characteristic divisions should not be carried to the extreme. The value of accurate labor relatives lies in their dependability from the standpoint of the *average* rather than the individual unit of plant. As to individual poles, for illustration, in the imaginary thirty foot fifty mile pole line mentioned above there is not the slightest doubt that some of the poles set in sandy loam would require a different number of man hours than other exactly similar poles set in the same kind of soil. The variation should not be excessive however although the determination of the required number of man hours for individual poles would be all but impossible.

(Please turn to page 34)

Authors Note: It is obviously impossible to include any complete system of Labor Relatives in a series of general articles. The utmost that can be done is to explain and illustrate methods to the end that the reader may adopt, if he wishes, an accurate method for use in his own work.

ON THE NEWS FRONT

Army

WITH the national defense program completed by Congressional approval of the National Guard mobilization and the Conscription plan, the telephone industry—both manufacturing and operating—will be called upon by the Army during the next few months to participate in the furnishing of communication facilities for the myriad of new cantonments and air fields that are to be established in all sections of the country. The Army Signal Corps has formulated detailed advance plans for communications requirements in connection with the National Guard mobilization and the conscription training so that they can be set in motion immediately and the telephone industry, both Bell System and Independents, have been working in closely coordinated cooperation to provide the facilities and equipment for the communications service of the expanded military forces.

During the next few months the location of the new cantonments and air fields will be determined by the Army and the command of the Signal Corps will instantly advise the telephone industry—the United States Independent Telephone Association in the case of the Independent industry—about the new sites. Thus, telephone companies, large and small, will be kept in touch with these developments so that when a new encampment or air field is placed in their territory they can spring into action to set up the telephone facilities which may be required. Because of the most excellent cooperation and high efficiency of the telephone industry, the Army authorities are relying wholeheartedly upon the private management of the industry to handle these communications problem. With this confidence on the part of the Army the present defense situation seems to offer no spectres of attempts for government ownership of communications. The government ownership threat was feared by some observers at the outset of the war emergency, but there is every indication that this "bug-a-boo' is not "in the cards."

The reports on citizenship and military service from all telephone employees, Bell System and Independents, will be of great value to the Army and other Federal Government agencies with national defense in communications. The information on the military experience of male employees will provide essential data for the Army Signal Corps for use if and when needed upon intensification of the war emergency. The United States Independent Telephone Association has sent copies of the Citizenship and Personnel Questionnaire to all Independent telephone companies with exchanges of more than 100 stations. It is imperative that all Independents, large and small, cooperate in the obtaining of this information about their employees for the Federal Government authorities.

▼

FCC Trends

TELEPHONE regulation activities by the Federal Communicatons Commission will be revived with the coming of fall and, while they specifically affect the Bell System companies, some of the trends of the FCC decisions are significant for the Independent industry. The two most important angles in the pending FCC telephone regulatory actions comprise the idea of placing interstate toll rates on a uniform basis in every section of the nation and a proposal to place any interstate traffic, even though in an exchange area, under Federal jurisdiction.

The theory of a nationwide uniform basis for toll rates was emphasized by the FCC in its recent decision ordering the Pacific Telephone and Telegraph Co. to reduce its interstate toll charges to the same level of the A. T. & T. Long Lines. The keynote of the FCC action was that there is no justification for the present setup of different levels of interstate message toll telephone rates in the United States. This FCC order, however, may be contested by the Pacific Telephone and Telegraph Co. in a review oral argument before the Commission next month. In its mandate for the toll rate reduction on the Pacific Coast, the FCC did not give any consideration to the subject of possible adjustment of the toll compensation division with Independent connecting companies in that region.

The proposal for the Commission to assume jurisdiction over interstate rates within a local exchange area has arisen in its proposed finding in connection with interstate interzone traffic in the extended exchange district of the two Kansas Cities, Mo. and Kans., but the Southwestern Bell Telephone Co. is contesting this ruling in an oral argument appeal before the Commission Sept. 12. Even if the FCC sustains its proposed findings, it is believed this jurisdictional issue will be brought before the courts for final determination.

The Southwestern Bell stressed that the FCC was endeavoring to expand its powers to regulate exchange rates which fell within the province of state commissions. This effort to impose Federal regulation over this type of exchange rates would "preclude progress in telephone rate treatment to meet new public requirements," the Southwestern Bell cited in pointing out that exchange areas were enlarged with the natural growth of communities and cities.

▼

Wage Hour

THE long-awaited review decision of the Wage-Hour Division on the Minimum wage exemption of learner telephone operators in the Independent industry is slated to be released soon. However, indications were that not much relief from the original ruling of a 25 cent per hour minimum wage and a 320-hour training period is to be afforded in the review decision. The exemption of learner operators applies to Independent telephone exchanges of 500 or more stations as exchanges below 500 stations are freed entirely from the Wage-Hour law through the Congressional amendment.

The review decision is understood to provide for the extension of the period of learner certificates for a full year until the end of 1941 instead of the expiration date of December 31, 1940, contained in the original finding. Some of the "red tape" provisions of the original order also have been eliminated or clarified, another important revision, it was indicated, was the elimination of the requirement that learner certificates could

By ROLAND C. DAVIES
Editor
Telecommunications Reports

not be issued if experienced operators were in the community and available for positions.

Another Wage-Hour decision to be issued during September is to be on the definition of executives, administrative and professional employees in telephone companies and in the telephone manufacturing industry so that these employees will be exempted from the maximum hours of work provision which is at present 42 hours a week and is later to be shortened to 40 hours.

▼

Government

WHETHER the FCC and the broadcasting industry are to be investigated by the Senate Interstate Commerce Committee at the present session of Congress will be determined before Congress takes its hoped-for recess towards the end of September for the month before the election. The Senate Interstate Commerce Committee also will decide whether to recommend for confirmation or to reject the nomination of Commissioner Thad H. Brown, Ohio Republican, for a seven-year reappointment to the FCC.

The proposal for an investigation of the FCC and its regulation of broadcasting—an issue which has bobbed up in every session of Congress since the Commission's creation in 1934—is sponsored by Senator Tobey, New Hampshire Republican, who has been the prime mover in opposing the confirmation of Commissioner Brown. During the two months of hearings on the FCC member, Senator Tobey directed an extensive probe by the Senate Committee into activities of the Radio Corporation of America in seeking the court trial continuance in 1932 of its "radio patent pool" anti-trust suit. His resolution for the Senate investigation of the FCC and broadcasting would delve into political influence and lobbying by the radio industry in seeking broadcasting station licenses. The White House may oppose the FCC vigorously which would dim its chances of Senate approval to a considerable degree. Caught in this controversy of a projected FCC investigation is the confirmation of Commissioner Brown and it may result that his reappointment may go by the boards without Senate sanction. The veteran FCC member has been serving without pay since his term expired July 1 and has not been able to participate in the affairs of the Commission.

▼

Regulation Fund

WHETHER the FCC will be successful in its third attempt to secure an additional appropriation of $142,000 for expansion of its telephone regulatory activities will be disclosed in the closing days of the present session of Congress when the House Appropriations Committee reports out the First Supplemental Emergency Civil appropriations bill which is similar to the usual final deficiency measure. The FCC has been refused this increased fund in two previous appropriations measures of this session in the case of its regular annual appropriation and a deficiency allotment.

If the Commission does secure Congressional sanction of this fund for increased telephone regulatory functioning, it plans to establish a special rate and research unit in its regular staff with a number of duties that bear important regulation aspects not only for the Bell System but for the Independent telephone field. One task would be the determination of a formula for depreciation accrual accounting; another activity would be the survey of telephone manufacturing costs and their relation to equipment prices; and the special unit also would be geared to extend assistance to state commissions in exchange rate investigations as well as performing regulation by the FCC of the interstate toll rates of the A. T. & T. Long Lines. An additional possible sphere of activity, projected under the expanded FCC regulation, would be the study of toll compensation divisions between the Bell System and Independent companies.

▼

REA Experiments

OF great significance to Independent telephone companies serving rural areas is the activity of the Rural Electrification Administration in experimenting with the possibilities of using carrier telephone circuits on the power lines serving REA cooperatives' terri-

(Please turn to page 33)

W. J. Cameron To Address National Convention

W. J. Cameron

ANNOUNCEMENT has been made by Louis Pitcher, executive vice president of the United States Independent Telephone Association, that W. J. Cameron had accepted an invitation of the Association to address its convention in October. Many of you have heard Mr. Cameron on your radio as he speaks on the Ford Motor Company Sunday Evening Hour. There will be other noted speakers to be announced. These will be carried in the Convention Number of TELEPHONE ENGINEER which will be delivered to you a week before the convention meets on Tuesday, October 15.

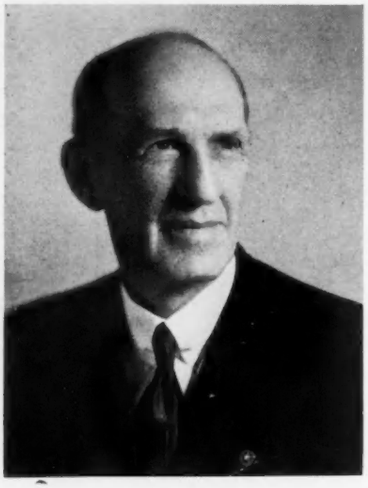
Prior to 1918, Mr. Cameron was on the editorial staff of the Detroit *News*, one of the largest and most influential newspapers in the Central West. He was with the *News* for about eighteen years, first as a reporter and then as an editorial writer. Many of his editorials have been widely reprinted; quoted in Congress and copied into the Congressional Record. One, entitled "Don't Die on Third," written twenty-seven years ago, probably has been reprinted a greater number of times than any other editorial ever written. It is included in the American Book Company's school readers, and has been used for years by entrants in the Michigan High School Forensic Association contests. In many instances it has been the prize-winning declamation.

Since 1918, Mr. Cameron has been with the Ford Motor Company. For the last five years he has been a speaker on the Ford Sunday Evening Hour.

Of recent years Mr. Cameron has—through no desire of his own—come into great demand as a speaker. Scarcely a day passes that he does not receive from ten to twenty invitations to address banquets, conventions or other formal gatherings in near or distant cities of the United States or Canada. He has also spoken from many influential pulpits.

He is of Scotch descent, about 60 years of age, and is a favorite speaker of Scottish groups at Burns' anniversary celebrations and gatherings of the St. Andrews' Societies.

Ohio Association Honors Hawaii Telephone Co.



John A. Balch

IN recognition of its outstanding services in the national defense, that have been and are now being rendered by the Mutual Telephone Company of Hawaii, which is smoothly and efficiently functioning as one of the most important links in Uncle Sam's communications network, the Board of Directors of the Ohio Independent Telephone Association, upon nomination by President J. Warren Safford and Secretary-Treasurer Frank L. McKinney, both recent visitors to the Islands, has voted its annual Public Service Honor Award to the Island Company, of which Mr. J. A. Balch is Chairman and Mr. Alvah A. Scott is President.

The Award is a handsome plaque in solid bronze, mounted upon a polished walnut base, and bears a laurel wreath in bold relief, with the words, "For Special Merit, Service—Progress—Success." It is a signal honor that is voted by the Buckeye Association, oldest and largest of the state independent telephone associations on the mainland, at intervals of one year or longer, to independent telephone companies that have distinguished themselves in the service of the public and materially assisted in the advancement of the telephone industry at large.

"In selecting the Mutual Telephone Company of Hawaii to receive our 1940 Honor Award," writes Secretary-Treasurer Frank L. McKinney to President Scott, "Our Association Board of Directors desires to congratulate all the members of the Mutual Telephone organization for their very real accomplishment in keeping your Hawaiian telephone plants in step with every recent advance in the telephone art.

"We are happy that our vital outposts in the Pacific are being well served by Independent telephone men and women of broad vision and patriotic devotion to the best traditions of American business."

During their recent visits to Oahu and the other Islands, Association President Safford and Secretary-Treasurer McKinney were particularly impressed with the speed and efficiency of Mutual's inter-island and mainland Radio telephone services, and with the elaborate arrangements that have been worked out to provide Navy, Army, Marine and Coast Guard organizations, with adequate communications for both routine and emergency needs.

The wide variety of problems presented by our Island physical conditions, demanding exceptional ingenuity and involved research on the part of local telephone engineers, brought complimentary comment from the Buckeye President.

"The Mutual Telephone Company of Hawaii has had some of the most complex operating situations to overcome that I have ever seen," he said.

"Here you have all of the problems common to coastwise telephone companies, plus those of the plains and mountain states, and in addition all of the difficulties that belong to a tropical plant location, such as insects that can devour unprotected poles, crossarms, and sometimes covered cable; mold and fungus that destroy like fire; and soil constituents that seek to dissolve even basic metals.

"Certainly there has been nothing of south seas languor about the manner your Company has functioned to reach its present proud position in the telephone field."

Alvah A. Scott

Obituary

David Franklin Houston, former Secretary of Agriculture and the Treasury under President Woodrow Wilson and for six years vice president of the American Telephone and Telegraph Co. and president of the Bell Telephone Securities Co., died Sept. 2 in a New York hospital after a short illness of heart disease at the age of 74 years. Mr. Houston, who was chairman of the board of the Mutual Life Insurance Company at the time of his death and a director of the A. T. & T., had carved for himself a career of notable public service both in the cabinet at Washington and in his posts in the business world.

Frank H. Bramon, 80, pioneer in development of Knox county, Neb. telephone service, died at Lincoln, Nebraska. For many years Mr. Bramon operated an exchange at Verdigre, Nebraska.

August Broelman, 80, died August 18 at Greenwich, Kansas. He had been manager of the Andover Telephone Company for many years.

William C. French, 63, owner of the Colwich (Kansas) Telephone Co., died Aug. 18, following a short illness.

Indiana Association Holding Conferences

The Indiana Telephone Association is very busy during September with seven managers' monferences to be held this month. Six were held during August. The seven to be held in September are as follows: at Knightstown, 11th; Tipton, 12th; Williamsport, 17th; Delphi, 18th; Georgetown, 24th; Princetown, 25th., and Sullivan, on the 25th. President Achatz and secretary Beck, of the Association are to be congratulated on this extensive conference program now in progress.

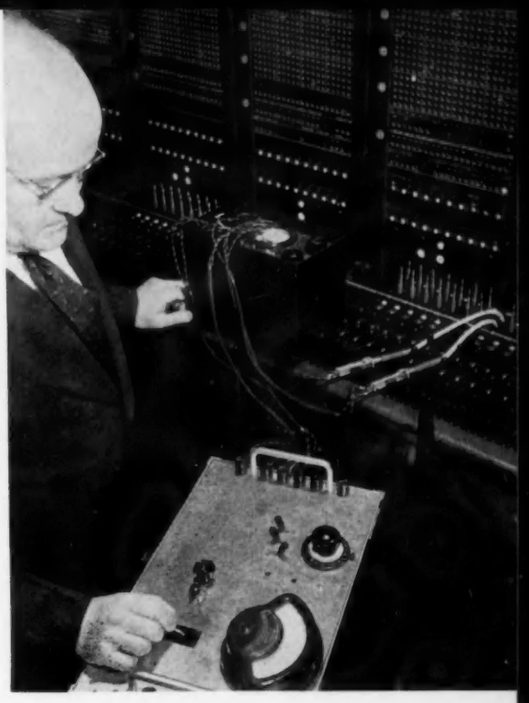
South Dakota Convention Will Meet October 3 and 4

The annual convention of the South Dakota Telephone Association will convene at the Hotel Cataract, Sioux Falls, on October 3rd and 4th. The meeting will be the last state convention to meet before the National convention in Chicago on October 15, 16, 17 and 18. The meeting of the Maine association is being held at the time this is written and will be reported in the October Fortnightly.

No Telephone— No Home!

When a fire broke out in Mudville, N. Y., Glen Smith, whose home was ablaze, had to go two miles to turn in a fire alarm because there was no telephone in the Livingston County hamlet. Meantime the house was razed.

The Longitudinal Circuit



By R. A. SHETZLINE

Interference Prevention Engineer, Bell Laboratories

SPEECH is transmitted over telephone lines by current that passes over one conductor of a pair and back over the other. Because both sides of the circuit consist of metal wires, such a current path has come to be called the metallic circuit. The term arose many years ago to distinguish this type of circuit from that formed by a single wire and ground. Even though a telephone circuit does not employ the ground as a return path, the effect of the ground is still present, with the result that the two wires of a telephone circuit, together with the ground, provide a second type of circuit known as the "longitudinal circuit." Over this circuit approximately equal currents flow in the same direction in both conductors of the metallic circuit and return to the source over the ground path.

The importance of the longitudinal circuit arises from the fact that many of the noise disturbances induced into telephone circuits from the outside enter by way of the longitudinal circuit. Since the two wires of a telephone pair, whether run on crossarms or in cable, are close together compared to the distance from the disturbing source, the voltages or currents induced in them are nearly the same. They are made almost exactly equal by transposition schemes for openwire pairs or by twisting in cable pairs. This is indicated in Figure 1. While there may be slightly more voltage induced in the T wire over one section, there will be proportionately more induced in the R wire over the next section, so that over the length of the exposure, the voltage is very closely the same in amount and direction in both conductors, and as a result the induced current flows over the longitudinal circuit.

So long as the current remains longitudinal, it will not disturb the speech communication, because only current in the metallic circuits can affect the telephone receivers at the ends of the line. Suppose, however, that such a longitudinal current has been induced in a line, and reaches a cord circuit at one end as shown in Figure 2a. In conductor R it encounters an impedance z due to the supervisory relay. Current I flowing through this impedance causes a voltage drop Iz. If there were a similar z in the T conductor, the two Iz voltage drops would be equal and opposite as far as the metallic circuit was concerned, and there would be no net effect. Since the z is in one line only, however, there is the single voltage Iz acting on the metallic circuit, and it results in a metallic-circuit current, which will be transmitted over the circuit just as the voice currents are. This effect is controlled in practice by restricting the magnitude of impedance unbalance z.

The basic cause of the transfer of current from the longitudinal to the metallic circuit is thus some form of unbalance—a lack of symmetry between the two sides of the line. It might have taken the form of a difference in capacitance between the sheath and the two wires of a cable pair, as indicated in Figure 2b, of a joint with appreciable resistance, of a tree leak, or of a ringer connected between one side of the line and ground, as in Figure 2c. It is always an unbalance of some sort, however, by which induced longitudinal currents enter the metallic circuit. If it were practicable to keep all telephone circuits perfectly balanced, both with respect to ground and outside disturbing sources, there would be no noise induced in them from the outside.

Besides being a link between outside disturbances and the telephone circuit, the longitudinal circuit may also act as a carrier of crosstalk. Voice current in one pair may induce longitudinal current in other pairs, and this, in turn, may become metallic-circuit current in these latter pairs. This situation becomes of particular importance at carrier frequencies because of the greater effect of small unbalanced capacitances. Its effect and reduction in the type-K carrier system have already been described.*

The types of unbalances shown in Figure 2 are of the obvious kind, but unbalances may exist that are not evident in a cursory examination of the circuit schematic. The repeating coil type of battery feed, shown in Figure 2a, might possibly provide an unbalance that would cause disturbances in the metallic circuit even though the supervisory relay were not in the circuit. The longitudinal line current coming in over the T and R leads normally passes to the ground at the midpoint of the coil. If, however, the windings are not perfectly balanced, the effect of the current in the T lead

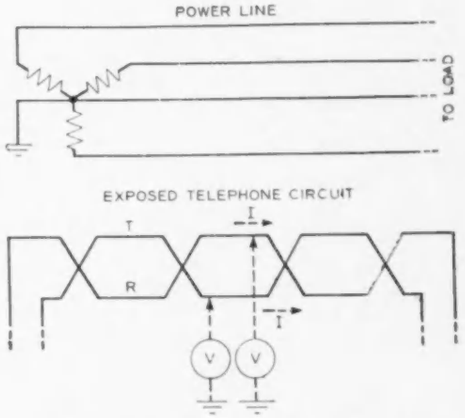


Fig. 1—Induction from an adjacent power circuit is primarily to the longitudinal circuit because of the transpositions.

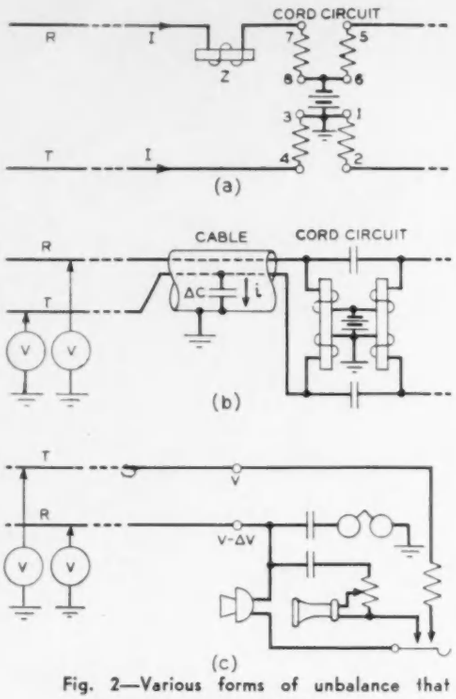


Fig. 2—Various forms of unbalance that may result in metallic-circuit current.

flowing in winding 4-3 will not exactly balance that of the current from the R lead flowing in winding 7-8, and as a result a net differential voltage will be induced in the metallic circuits of windings 2-1 and 6-5.

In this particular case the unbalance is most likely of the inductive type, and is best reduced by use of a bifilar winding. The wire for coils 4-3 and 7-8 are placed side by side and wound on at the same time so that the windings are as nearly identical as they can be made. With this type of winding, the unbalance is very small. The same construction could be used for windings 1-2 and 5-6.

In an arrangement such as shown in Figure 3a, the longitudinal current does not flow to ground conductively, as in Figure 2a, but through the various inter-coil capacitances as shown in Figure 3b.

To avoid an unbalance, capacitance A must equal A', B equal B', C equal C' and D equal D' except where certain unbalances can be paired to cancel. Only the most careful design and construction of loading coils will keep these unbalances to the desired minimum.

VERY often a perfectly balanced circuit either is too costly to be warranted or is not possible, and other methods must be employed to prevent the longitudinal current from seriously affecting the metallic circuit. Perhaps the most obvious and widely used method is that of shielding. In principle this consists in providing a grounded external circuit over which longitudinal current may flow, thus reducing the effect on the telephone circuit. Shielding is particularly effective against electrostatically induced disturbances, because the shield acts as a barrier beyond which the electric field cannot pass. A shield unless of highly magnetic material, however, does not form a complete barrier to a magnetic field, but in spite of this fact it does exert a shielding effect. Perhaps the simplest explanation is that the disturbing flux produces longitudinal current both in the conductors and in the shield, but the current in the shield also induces a current in the conductors, which is in the opposite direction, and thus provides a compensating effect. The lead sheath of a telephone cable is a common example. Here an outside disturbance induces a longitudinal current in the sheath, and since this sheath, as well as the longitudinal current it carries, completely surrounds the conductors inside, the longitudinal current is reduced. Shielding is particularly effective at the higher frequencies, and the coaxial conductor, which is a completely unbalanced circuit, owes its freedom from induced disturbances to effective shielding provided by the outer conductor at very high frequencies.

Another method of reducing longitudinal current is by the use of choke coils inductively coupled so that they offer a high impedance to longitudinal current but very little impedance to the metallic-circuit current. In Figure 4, for example, which is like Figure 2a, choke coils have been inserted and so poled that flux due to metallic-circuit current flowing in the upper coil from 1 to 2 opposes that due to current flowing back through the lower coil from 4 to 3, and thus the only impedance offered is the resistance of the coils, which is small. To longitudinal current, however, flowing from left to right through both windings, thus reversing the effect of the lower coil, a high impedance is offered.

The action of these coils depends on whether the longitudinal current is in-

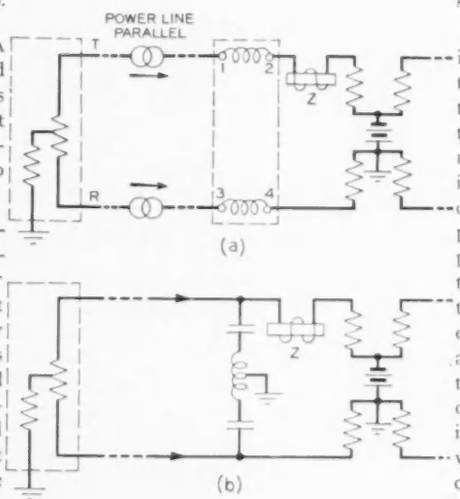


Fig. 4—Choke coils may be used to reduce longitudinal current, as at (a), or drainage coils to drain the current off, as at (b).

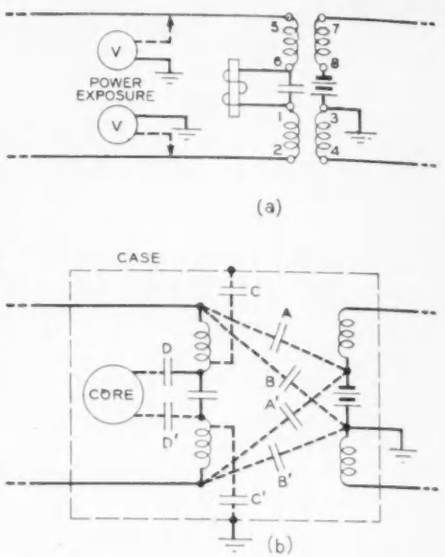


Fig. 3—Where the only path for the longitudinal current is inner-coil capacitance, careful design and construction is required to secure adequate balance.

duced inductively or capacitively. The conditions for disturbances due to magnetic induction are indicated in Figure 5a. The induced voltage e depends on the current flowing in the power line and the distance of the power line from the telephone line, and not on the characteristics of the telephone line. The disturbing current that flows, however, is equal to this voltage divided by the impedance of the complete longitudinal circuit, which consists for the most part of the resistance of the wires plus the impedance to ground of the terminal apparatus including the entrance cable. This impedance is not very high, so that by inserting high-impedance choke coils, the total impedance can be greatly increased and the disturbing current in the telephone circuit greatly diminished.

If, on the other hand, the disturbance is induced through the capacity between the power and telephone lines, the situation is as indicated in Figure 5b. Here the voltage-to-ground of the power line, E, induces a disturbing current that is inversely proportional to the impedance, consisting of the capacitance between the power and telephone lines plus the impedance to ground at the two ends of the telephone circuit. The capacitance between power and telephone line, however, is very small and thus its impedance is very high—probably hundreds of times greater than that of the telephone circuit to ground. Because of this, the impedance of the telephone circuit has very little effect on the total disturbing current, and even if a choke coil of high impedance compared to that of the telephone circuit is inserted, the total disturbing current will not be greatly re-

(Please turn to page 48)

Short Course in Telephone Transmission

By
B. C. BURDEN

Subject – Transmission Measurements

General

ONE OF the most important phases of telephone transmission work is the measurement of telephone circuits and apparatus to insure that they are operating satisfactorily and capable of providing good transmission.

In the maintenance of telephone circuits we are concerned with two basic types of electrical tests or measurements, viz:

(1) **Continuity and leakage tests.**

(2) **Transmission tests.**

Continuity and **leakage** tests are made on all lines which are in trouble to determine the cause or type of trouble or on a routine basis to detect incipient trouble.

Such tests are made with a voltmeter and battery (acting as an ohmmeter). When properly made, these tests will as a general rule show whether or not good transmission can be given over a circuit. This is particularly true where the overall resistance of a telephone circuit is measured and compared with the computed value for the length circuit involved. Ohmmeter tests do not, however, give as complete a check of the talking performance of a telephone circuit as does a regular **transmission measurement,** hence periodic transmission checks of circuits and apparatus, particularly toll, are desirable. A transmission measurement will show up certain types of electrical defects in circuits and apparatus that might be overlooked in continuity and leakage measurements.

The Several Types of Transmission Measurements

THE TERM **transmission measurement,** as generally used, refers to the measurement of circuit or apparatus voice frequency attenuation and is expressed in decibels. Broadly speaking, transmission measurements include several different types of tests or measurements which may affect transmission, these are:

(1) **Attenuation** measurements (expressed in decibels).

(2) **Crosstalk** measurements (exressed in crosstalk units).

(3) **Noise** measurements (expressed in noise units).

There are three other types of measurements that the transmission engineer may be called on to make and which, tho they pertain to transmission, are not strictly transmission measurements as were the three mentioned above. These additional measurements are:

(1) **Frequency response** measurements.

(2) **Impedance** measurements.

(3) **Capacity unbalance** measurements.

Let us consider all six types of measurements separately and in the order of their importance.

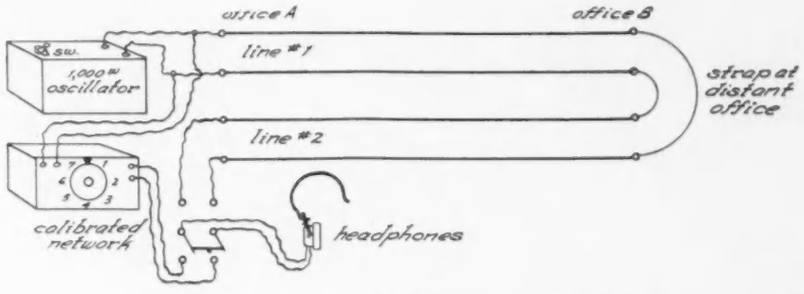


Fig. 1—Ear balance testing method on loop back basis.

Attenuation Measurements

THE MOST important of the several transmission measurements is the measurement of attenuation.

The ability to carry on an understandable conversation over a telephone circuit depends largely on the relative magnitude of resistance, inductance, and capacity in the circuit. Due to the complex electrical network characteristics of a telephone line, the measurements of any one of the above qualities of the telephone circuit. It has been determined, both experimentally and mathematically, that the measured ability of any telephone circuit or piece of apparatus to convey a 1000 cycle current will give a fairly accurate measurement of the voice carrying qualities of the line or apparatus as far as ordinary telephone conversations are concerned.

The transmission ability of telephone

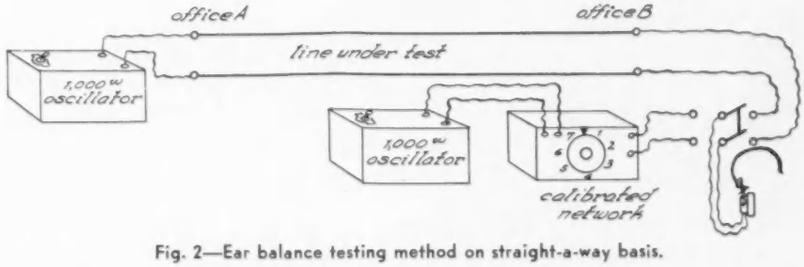


Fig. 2—Ear balance testing method on straight-a-way basis.

circuits and lines is therefore determined by measuring the loss (**attenuation**) which a 1000 cycle current suffers in passing through the circuit under measurement. The results of these measurements are expressed in **decibels,** and are properly referred to as attenuation measurements.

For example, if we apply a known source of 1000 cycle current to a metallic iron wire line (No. 109 iron) and find that at the receiving end of the line we get only one-half of the input current (the rest having been dissipated in the line) then we would say that our line has an attenuation loss of 6.0 db. Note—A current ratio of 0.5 is equal to 6.0 db.

By comparing the attenuation in db obtained by measurement with the computed values for the length circuit or type apparatus involved, any excess loss is immediately observed.

Methods of Measuring Attenuation

THE ATTENUATION loss of telephone circuits can be determined by either of two basic types of measurements, viz:

(1) By the **ear balance substitution method.**

(2) By **voltage, current, or power measurements.**

The **ear balance substitution** method requires the use of a special transmission measuring set which contains essentially a variable resistance network calibrated in db, a head phone, and a manual switching arrangement. This set must be used in conjunction with a 1000 cycle oscillator.

Operation of the ear balance set is as follows: The theory of operation of the ear balance method is that energy from a 1000 cycle oscillator is arranged to feed into both the line (or apparatus) under test and into a db calibrated network in the measuring set. The output end of the line is also connected to the measuring set. The tester listening on the headphone connected to the measuring set first observes the volume of the 1000 cycle tone as heard at the output end of the circuit under test, and then by means of a switching key the headphone is transferred to the output side of the calibrated network and the network adjusted to give approximately the same volume as was heard on the output end of the telephone circuit. When the adjustment is such that equal volume is obtained, either direct or through the adjustable network, then the loss in db of the circuit under test can be read directly from the network calibrated dial. Fig. 1 shows schematically the general features of this method of testing.

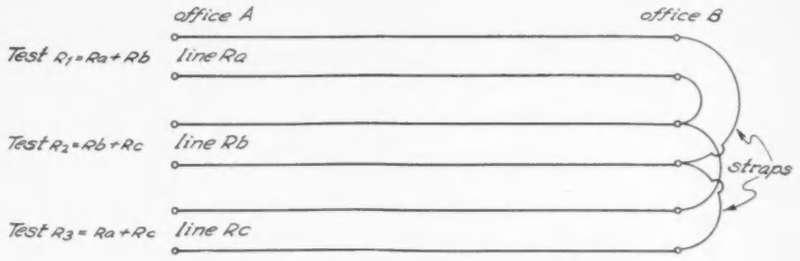


Fig. 3—Triangulation method of measuring individual losses.

Loop Back vs. Straight-Away Testing

WITH this method of measurement, it is necessary to loop the circuit under test back to the testing point by using another circuit, inasmuch as the transmission measuring set must be connected to both the output end of the circuit under test and the testing oscillator. This is a distinct disadvantage of this testing method. It would of course be feasible to use two separate oscillators, whose power outputs were identical, and by feeding one oscillator into the input end of the line under test and the other into the measuring set, the set could be located at the output end of the circuit under test without the necessity of looping back through another circuit. Fig. 2 shows how two oscillators could be used for straight away testing.

Where a single oscillator is used and the output end looped back thru a second line, the tester should not overlook the fact that the measurement obtained contains the attenuation of both the circuit under test and the "loop back" circuit.

If three circuits are available the loss of any individual circuit can be obtained by the familiar **triangulation method,** (see Fig. 3) wherein three separate readings are taken and then combined in the equation given below.

$$\text{Test } R_1 = R_a + R_b$$

$$\text{Test } R_2 = R_c + R_b$$

$$\text{Test } R_3 = R_a + R_c$$

$$\text{Loss of Cct. } R_a = \frac{R_3 + R_1 - R_2}{2}$$

$$\text{Loss of Cct. } R_b = \frac{R_1 + R_2 - R_3}{2}$$

$$\text{Loss of Cct. } R_c = \frac{R_2 + R_3 - R_1}{2}$$

(Please turn to page 46)

"Thank You, Milt Stewart"

(The following is taken from one of the Bulletins issued by the Pennsylvania Independent Telephone Association Bulletin edited by Secretary Milton Stewart)

Inasmuch as the primary functions of our Association are limited to Pennsylvania, we naturally confine our General Letters and Bulletins to items of a local nature or of specific interest; with certain exceptions, of course. This does not imply that Pennsylvania telephone men can afford to remain indifferent to what is going on elsewhere. The effect of diminishing distances upon our Industry is no less than upon national economics, or upon international trade. The success of a telephone company in Pennsylvania is influenced by what is being done by telephone men in Texas. A departure in regulation by a Commission in Minnesota, a new statute enacted by the California legislature, or the opinion of a Florida Court may deflect the compass by which a Pennsylvania telephone manager steers his course, as they reflect the trend of public opinion or become the predicate for similar action at home.

As we have said, it is obviously not within our province to collect and relay all such facts and data; especially when our activity in this direction would suplicate the work of those who make a speciality of collecting and disseminating information on a national scale. There are several mediums through which telephone men can be currently informed on matters of direct interest to their Industry, including the Bulletins issued by the National Association, Telecommunications Reports, Public Utilities Fortnightly, Telephony, and TELEPHONE ENGINEER. The last two periodicals are "Trade Journals", conceived and nurtured by Independent telephony, and now devoted exclusively to the Telephone Industry, and are the source of much dependable information.

Sell Telephones By Engineering Principles

ATWELL JACKSON
Telephone Sales Consultant for
TELEPHONE ENGINEER

By ATWELL JACKSON

EVERY engineer in the industry who is working at trouble shooting, or research, or service extension is continuously at work attempting to overcome the hazards and difficulties set up by natural elements.

The laws of gravity, the danger of friction, the elements of resistance have established certain barriers which challenge the skill of the engineer to overcome them in order to attain his mission.

The simple erection of poles on certain types of soil creates problems to solve which demand the experience and schooling of the most seasoned men.

In other words every construction job, every extension, every act of servicing of equipment finds that the natural elements set up a big **"NO,"** which require some sort of a mathematical solution. Whether nature has set up the "no" as a bar to mans' progress is beside the point in this article.

The fact that men labor long and earnestly in order to solve a particular difficult problem in engineering is only because the natural elements of many sources combine to produce obstacles to hold back the efforts of progress What sets up these obstacles and why is something which is within the compass of the practical engineer.

Yet, despite these hazards of weather; despite the difficulties of changing temperatures; despite the apparent insurmountable obstacles which engineers in the telephone industry face daily—the business of serving the public with a communications system goes onward and is constantly improving.

THESE obstacles are tangible obstacles—at least they can be made so by the engineer and are made definite before he makes any attempt to overcome them. A particular condition affecting service requires particular skill to overcome it—but before the engineer makes any attempt to actually overcome the condition—HE FIRST ESTALBISHES WHAT THE CONDITION IS THAT MUST BE OVERCOME.

Reverting to the condition of difficulty in erection of a telephone pole, it may be because of silt in the soil, or rock, or shifting conditions in the surface of the earth—but whatever it is, the engineer studies specifically what it is that obstructs his program, and then he **establishes a means of overcoming the difficulty to the satisfaction of his company's service.**

Specifically—there are also similar conditions facing the sales department. There is what we term **sales resistance!** This sales resistance is merely an obstacle to obtaining sales — fundamentally not unlike the obstacle that faces the engineer in his servicing problem.

BUT THE ENGINEER GOES AHEAD BY FIRST RECOGNIZING THE PROBLEM — DEFINING HIS OBSTACLE AND THEN OVERCOMING THE OBSTACLES BY METHOD, PLAN, AND PERSISTENCY. The engineer when he discovers a problem that is a handicap to his work—does not throw it aside and look for work in another direction—HE SETS ABOUT TO OVERCOME THAT SPECIFIC OBSTACLE AND IT IS DUE TO THE OVERCOMING OF THESE DIFFICULTIES AND THESE OBSTACLES BY THESE HARD WORKING ENGINEERS THAT HAVE MADE THE WONDERFUL SERVICES OF YOUR COMPANY A REALITY.

HOWEVER—in the sales department, when a natural obstacle on the part of the buying public arises, the sales department alibis, quibbles, stalls or passes the buck—and then instead of sticking to the ground and overcoming the obstacle, seeks so called new prospecting, only to discover obstacles of a different type and again jumps of the merry-go-round to other fields.

The basic difference between the **functioning** of an engineer and a salesman is the engineer looks for obstacles with an objective in overcoming them —the salesman looks for "yeses" with little consideration of an analysis and overcoming of a "no."

Companies who operate in the rural districts especially, have long taken the "no" of the farmer as final—and found every reason under the sun to agree with the farmer and his "no" letting it go at that and bemoaning the fact that the farmer will not say "yes" to installing a phone. However, suppose the farmer does say "yes" and when the extension lines are run from the road to the home of the farmer the construction department finds a particularly marshy patch over which the poles must be erected. Does the engineer throw up the job because he has met with resistance? Does he leave the scene of trouble to go over to firmer ground a mile or two away and then try to erect the poles? Or does he buckle down to the job and use his skill, experience and knowledge to overcome the obstacle and never leave the scene until his job is done, inspected and passed. Selling the farmer should follow this same path.

It is true that the nature of engineering is such to ananlze of the problem can be made on a more tangible basis than a salesman makes a selling analysis. Yet what may look tangible to one not familiar with engineering, is highly intangible to the engineer.

The difference is one of mental attitude. The difference is one that has defined the job of engineering as a pro-

fession and the usual job of selling as accidental.

The mental attitude of the engineer is one of definitizing. The mental attitude of the salesman is one of "Hope." The engineer pitches in to meet obstruction on its own terms. The salesman usually goes by guesswork. The engineer knows what he wants to do in a definite manner. The salesman works on what he calls the law of averages.

Selling can be quite as professional as engineering. Only after it faces the "No" with the same mental attitude that the engineer faces the "No." The engineer converts the "no" into a "yes"—and when salesmen recognize obstacles as a natural factor in selling and see the "no" of the prospect as an element to be overcome and not to discourage—then the higher proportion of "no's" will be turned into "yeses."

Resigns Presidency of General Tel. Corp.

The General Telephone Corporation announced Sept. 4 that John Winn has resigned as President and Director of the Corporation and from all the posts in it subsidiaries which he was connected.

Mr. Winn, who had served at the first president of the General Telephone Corporation since it was established after the reorganization of the Associated Telephone Utilities Co., has had 30 years service in the telephone industry and during the last four years has headed the General Telephone Corporation.

The retiring General Telephone president, who is on vacation in Maine, stated that it was his belief the General Telephone System was never in finer condition than at present. During Mr. Winn's administration the General Telephone System has made substantial growth in the number of stations in service and in earnings. The General Telephone System now has more than 518,000 telephones in service. The System's consolidated earnings per share of common stock for the 12 months ended June 30, 1940, were $2.69 a share.

The next meeting of the board of directors of the General Telephone Corporation will be Sept. 27 at which time the selection of his successor may arise.

Prior to joining the General Telephone Corporation in 1936, Mr. Winn had had 26 years of service with the Bell System. He had been with the New England Telephone & Telegraph, New Jersey Bell and with the New York Telephone Co. He was the New York Telephone Co. plant extension engineer for the Upstate area when he was named to the General Telephone presidency.

California Company Announces Modernization

According to R. E. Bennett, recently elected secretary of the California Independent Telephone Association, the announcement has been made of a complete modernization program at Ferndale has been made by William Vaughn, manager of the Public Utilities California Corp.

Late type dial installation will be made and it is estimated that three to five months will be necessary before it is completed. Some 525 telephones in Ferndale and the surrounding valleys will be served by the company, all of which will be replaced in addition to new central office equipment.

Kansas Company Moves Headquarters

The Central Kansas Telephone Company will move its general offices from Topeka to Osawatomie, Kan., November 1, according to V. E. Code, general manager.

The company operates in several counties in southeastern Kansas and Osawatonie is closer to their exchanges than Topeka. In Linn county the company owns Mound City and Parker exchanges.

$2.50 FOR NEW IDEAS $2.50

Yes sir! QUIZZICUS will pay for all acceptable ideas that qualify for the feature right under this announcement. YOU have thought of many products—gadgets, etc., so here is your chance to earn a little money for your thoughts. Address your ideas to "Quizzicus," c/o TELEPHONE ENGINEER, 7720 Sheridan Road, Chicago, and if they "make" his feature you get $2.50 for each acceptable idea.

I WONDER WHY SOMEONE DOESN'T INVENT

by Quizzicus

A metal wall niche to accommodate a telephone for installation in residences.

A two-wheel trailer with necessary compartments for the hauling of tools and material for use on telephone installations.

An instrument by which wiping metal may be tested in the pot on the job to determine its lead and tin content.

A float type instrument to accurately indicate the electrolyte level in a sealed glass jar storage battery.

A metal cabinet to inclose manual switchboards similar to modern metal furniture and used to replace the old fashioned variety of wood cabinets.

A simple means of testing an earth anchor after it has been set in the line to make sure that it will carry the load intended.

(Quizzicus is anxious to have YOUR suggestions on products that will make your job easier and improve the telephone art. Address your suggestion to Quizzicus c/o TELEPHONE ENGINEER.)

a Pleased Subscriber-

Most Important to Telephone Company Prosperity is the Complete and Genuine Satisfaction of its Subscribers . . .

AN EXPRESSION of commendation from a pleased subscriber is the best tonic a telephone manager can take. He knows that customer satisfaction is the substance of telephone company prosperity — and without such nourishment telephone company profits literally starve to death.

Many alert operating companies are finding that handsome, modern Type 40 Monophones bring an immediate response from users commenting on their superior convenience and beauty. Here are some typical enthusiastic subscriber comments. "Talks up with greater naturalness and clarity than any telephone I've ever had." "Modern in every line — a really beautiful instrument." "Handset is light and well-balanced—not at all tiresome to use." These and similarly favorable remarks point to the increased subscriber satisfaction that this new Monophone is generating in every part of the country.

Why not put a pleased expression on the faces of all your subscribers, by providing them with Type 40 Monophones? We believe the dividends will be well worthwhile—both in stimulation of new business and general improvement in public goodwill. Write for prices and full information—today!

SEND FOR FREE SUPPLY OF THESE ENVELOPE STUFFERS!

These two-color envelope stuffers are designed for "consumer promotion" — to encourage the use of Monophones and telephone service in your area. They can be readily enclosed with monthly bills, or sent out separately to prospects and users.

We will gladly supply you with quantities of either style stuffer free of charge. One describes the manual type desk Monophone, the other the automatic type instrument. Write for your supply at once!

AUTOMATIC ELECTRIC

MAKERS OF TELEPHONE, SIGNALING AND COMMUNICATION APPARATUS
ELECTRICAL ENGINEERS, DESIGNERS AND CONSULTANTS

Distributors in U. S. and Possessions:
AMERICAN AUTOMATIC ELECTRIC SALES COMPANY, 1033 W. Van Buren St., Chicago, U. S. A.
Export Distributors: AUTOMATIC ELECTRIC SALES COMPANY, LIMITED

LINE and DESK

RAY BLAIN, Editor

Q. When using the one cut or sloping method of pole roofing how should the measurements be made between the roof and the first gain?

A. This measurement should be made from the top of the gain to the high point of the roof and the distance is usually 8".

Q. Can you inform us whether there is any danger of overloading our cable reel trailer when used with the larger sizes of cable reels now being supplied by cable manufacturers?

A. You are not very definite as to the size of your trailer or the length of cable you expect to place on one reel. A reel size should be specified which will not overload your particular trailer. As an example a cable reel trailer equipped with 9.75/20 single pneumatic tires would have a pay load capacity of only 4430 pounds. However, since tire manufacturers ratings are based on full load at high speeds and since cable reel trailers are under load only intermittently and ordinarily never towed at high speed, most operating companies feel that on cable reel and pole trailers the tire carrying capacity may be increased approximately 40% for slow speed service. Following this observation the trailer equipped with 9.75/20 single tires would have a net load carrying capacity of approximately 7600 pounds. This load ordinarily exceeds the average cable reel weight.

Q. We are having trouble with some of our twisted pair copper wire drops in the rural districts, where the distance between the pole line and the residence is longer than usual, due to the rubbing of the two wires of the drop as it swings from side to side in the wind. Is there any approved kind of twisted pair wire that will show longer life under these circumstances?

A. In many companies the use of twisted pair iron drop wire has been found to reduce this sort of trouble. Because the twisted pair iron is so much stiffer than would be the case with wire of softer metal the two wires of the pair do not rub against each other so much and the insulation seems to have longer life. Care must be exercised, however, in making the tap at the pole when copper line wire and iron drop wire is used. The tap to the line wire should be carefully made with a split splicing sleeve of the proper wire sizes or if the sleeve is not used then the tap must be soldered.

Q. We are contemplating a change over of a large number of old side tone type telephones for the new anti-side tone subscribers sets if we can be sure that a definite gain in transmission may be realized. Can you give us any information on this subject?

A. We suggest that you consult the manufacturers of this instrument as you can safely follow their recomendations in connection with your transmission problems. The anti-side tone circuit arrangement provides a definite gain in the average transmitting volume efficiency because the reduced side tone from the speaker causes him to talk louder and more natural. There is an increase also in receiving volume efficiency due to a reduction in the disturbing effect of room noise. The new anti-side tone set is slightly lower in transmitting and receiving volume efficiency than is the side-tone set, since the ideal requirement can only be partially fulfilled, but its large reduction in side-tone, amounting to some 10 db, results in an effective over-all gain in transmission of about 6 db. Authorities differ on the actual effective gain but all agree that it is considerable.

The reduction of side-tone in this set is due to the proper use of a three winding induction coil. The variable currents caused by a station's own transmitter are in opposite directions in transmitter winding to that of the line winding which tend to neutralize each other in their effect in the third or receiver winding of the induction coil. The inductive balance necessary for complete neutrality in this respect is dependent on the relative impedence of the local circuit containing the coil, condenser and transmitter and line circuit winding of the induction coil. Since the line conditions vary with different lengths of line, the set is balanced for the characteristic impedance of a typical line (550 to 600 ohms). As the line departs from this, side tone will increase, but commercial lines are generally within such limits that when connected for talking the side tone is not objectionable.

Q. Please advise us with reference to a good method of making pair counts at a cable terminal?

A. One good method is to place a lead strap around the cable near the terminal and stamp the pair count on it with a tool marking set.

Q. When using the eye-bolt method of guying is it necessary to use a thimble as when guying with the old type anchor rods?

A. No this thimble is not necessary if the thimble-eye bolts and nuts are used. Both the straight and angle guy-eye bolts are now on the market.

Q. Will you advise us with reference to a good cleaner and dressing for use on the face of power switchboards of the telephone variety?

A. A very good polish may be made-up locally by mixing one part mineral oil with two parts benzine. This polish may also be used to advantage in the cleaning of the woodwork on a switchboard. When used on the face of a power panel the polish should be used sparingly and rubbed out well.

Q. What type of take-up and pay-out reel is considered best for drop wire use?

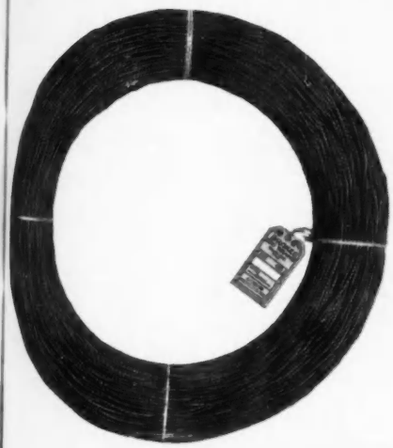
A. We prefer the all-metal type which is commonly used with trouble and light installation trucks. This type reel is generally mounted on one side of the truck body. A reel should be fitted with a brake which may be applied lightly so as to prevent the reel from running free and tangling the wire when being pulled-out by one man.

Q. Is it possible to obtain an angle iron pole top extension to support a drop wire at a greater height than the pole line so that the wire may clear a road or street crossing?

A. Yes several types of such pole extensions 78", 90" and 96" in length are now available and may be purchased at a reasonable cost. One such type is constructed of rigid, flanged steel, channel. Two holes with 18" spacing are provided at the lower end for crossarm or through bolt mounting. Four holes at the top allow for bracket attachment. Special hole spacing and lengths may be obtained when desired at a slight increase in cost.

ADDRESS YOUR QUESTIONS TO LINE & DESK. NO CHARGE FOR THE ANSWERS.

Stromberg-Carlson Selected Materials for Fall Construction



Habirshaw No. 17 Bronze Drop Wire

The conductor is a special high tensile strength alloy. It is insulated with a rubber compound of strong mechanical and high electrical characteristics, designed to resist oxidation caused by exposure. To further prolong the life of this rubber insulation, a closely woven cotton braid of highest quality double ply cotton yarn is used. This braid is impregnated with an asphalt saturator that thoroughly penetrates every fiber of the cotton and is finished with a special pitch compound to seal out the destructive agents, moisture and air.

TELEPHONE POLES

Stromberg-Carlson handles three types of telephone poles: Northern White, Western Red and Creosoted Southern Pine Poles. The Stromberg-Carlson organization feels that both the cedar and pine timbers provide entirely satisfactory poles. Each kind of timber has its particular qualifications and for some users one may be better than another, while for others the opposite may be true. Stromberg-Carlson has made arrangements with the leading producers and treaters of all types of poles, insuring an adequate supply constantly available.

← HTL-85 High Tensile Strength CRAPO Galvanized Iron Telephone Wire

Telephone companies can now lower construction cost, reduce maintenance expense and improve service by using this low resistance line wire for long rural lines. It makes possible spans of 225′ in heavy, 325′ in medium and 375′ in light loading districts and provides stronger, safer spans on existing pole structures. Its superior transmission qualities contribute to improved service and make for greater customer satisfaction. Available in size numbers: 9, 10, 12 and 14 B.W.G.

EVERSTICK Expanding Anchors →

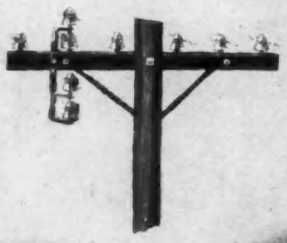
Made of Certified Malleable Iron. Available in several types of 2, 3 and 4-way anchors. Also, the Malleable Iron Cone Anchor in several sizes. For tight, tenacious, safe guy anchoring, for holding power to stand up under all conditions, for lowest cost installation, the EVERSTICK Anchor is supreme.

← NICOPRESS TOOL No. 31-D

11″ long, weighs 2 lbs. and is designed for high tensile telephone, telegraph and signal wires. Simple to operate, strong and durable; possesses maximum flexibility. It is so efficient in use that pressure can be applied with minimum physical strength and the assurance that each compression made will be exactly as required for a 100% splice.

CROSS ARMS and HARDWARE →

Stromberg-Carlson is in a position to furnish all types of material for line construction. Cross arms, insulators, brackets, pins and hardware.

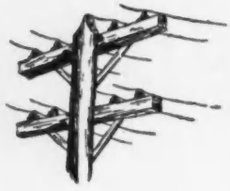


Make us your Jobber

Stromberg-Carlson

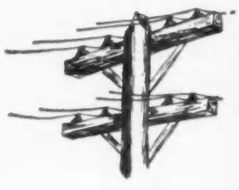
MAKERS OF VOICE TRANSMISSION AND VOICE RECEPTION APPARATUS FOR FORTY-FIVE YEARS

Stromberg-Carlson Telephone Mfg. Co., Factory and General Offices: 100 Carlson Road, Rochester, N. Y., U. S. A. Branch Offices: Chicago, Kansas City, San Francisco, Toronto



LONG LINES

R. A. Clark, Jr.



Carrier Telephone and Telegraph Systems

Considerable interest has been shown in carrier telephone and telegraph apparatus during recent years due to the economies which can be obtained. In this, the first of several articles, a brief history of the art will be discussed together with some of the problems as applying primarily to railroads, power companies and pipe lines.

THE history of carrier current communication dates back to about 1886 when Elisha Gray derived the theory of carrier current operation and built a multiplex telegraph system using vibrators and tuned reeds to provide the selective signaling. The same principle is followed today except that we use vacuum tubes to generate the alternating current instead of mechanical vibrators and electric filter circuits to separate the signals at the receiving end. Professor Gray set up his carrier telegraph system in wires of the Postal Telegraph Cable Company between New York and Chicago, and according to historical reports obtained satisfactory communication. However, thhere were definite limitations due mainly to the fact that the selectivity of the tuning system was insufficient to prevent interference. A few years later Professor Pupin devised a method of obtaining selectivity by means of electrical tuning. This was the origination of the electrical filter design which has made carrier current operation the success it now is. The development of electrical filters continued and neared perfection with the work of Campbell who obtained a number of patents in 1917.

The theory of carrier current telephony was developed and presented about 1891 by Hutin and Leblano (Patent No. 596017). While the theory was correct the practical difficulties could not be overcome at that time due to the lack of suitable sources of alternating current and methods of controlling them; the matter of separating the signals by means of filters was not yet fully comprehended. In 1911 General Squires obtained patents and demonstrated a carrier telephone system between New York and Baltimore. This demonstration was probably one of the first successfully conducted to show the possibility of carrier current operation.

Theoretically, there is almost no limit to the number of telephone or telegraph circuits which can be obtained by means of carrier current operation over one pair of wires. Practically, however, at this time we can obtain on one pair of wires either one or two d-c telegraph circuits, one voice frequency telephone circuit and as many as twenty-five carrier duplex telegraph circuits or five carrier telephone circuits. If a combination of telegraph and telephone circuits are required, several duplex carrier telegraph circuits and carrier telephone circuits man be obtained. The greater the number of derived circuits either telephone or telegraph, the higher the frequency band to be transmitted over the wires. Each telephone circuit requires a group of frequencies about 6,000 cycles in width. In order to transmit two carrier telephone circuits we require a transmission band extending up to about 18,000 cycles.

Recent tests on railroad owned wires indicate that it will be possible to employ frequencies as high as 100,000 cycles. This obviously will allow a great number of channels to be installed on a pair of wires. The actual limit is somewhat indefinite and more field experience will be necesstry before we will know definitely how far the band can be extended upward. However there

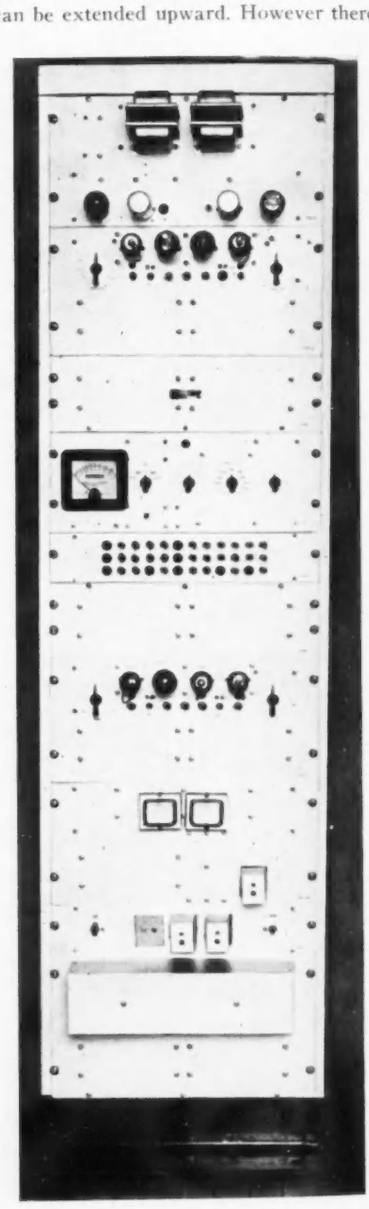


Fig. 1—Typical Carrier Telephone Terminal

is no question as to the operation below 50 or 60 KC. This obviously will take care of communication requirements for some time to come. Some modifications may be necessary on open wire lines when the higher frequencies are employed, however experience indicates that the cost of placing the lines in condition for frequencies up to 30,000 or 40,000 cycles will not be excessive.

The chief requirements for carrier telegraph circuits are as follows: The speed should be adequate for printer operation either the start-stop type or multiplex. In some applications single line operation is desired, in others duplex operation must be provided. The equipment should be of such type that it can be installed quickly and easily. Portability is desirable so that in emergency the equipment can be readily moved. The carrier system used for single line operation should be of such type and design that intermediate way station connections may be obtained. In other words, it should be possible to set up several carrier terminals on a circuit whereby any one terminal could talk to or break any other in the same manner as the closed Morse loop circuit.

THE carrier telegraph equipment should be so designed that it will not be susceptible to minor transmission equivalent changes such as occasioned by weather variations or the bridging of a lineman's test set. The equipment must not be sensitive to normal induction from power line exposures or signal impulses such as dispatcher selective ringing or d-c telegraph. We have found it necessary to modify dispatching equipment and d-c telegraph in some instances to prevent sparking contacts from interferring with the carrier operation; however, such modifications are relatively simple and inexpensive. Needless to say, the carrier telegraph signals must not interfere with the operation of the telephone circuit on which it is superimposed. Suitable operating levels together with filters at the terminals and way stations will eliminate such trouble.

Somewhat similar requirements apply to carrier telephone equipment especially as regards interference between the physical circuits and the carrier and vice versa. Other features which are desirable include the following: The voice transmission equivalent should be maintained constant regardless of weather changes affecting the carrier equivalent. The signaling system should permit the use of either 16 cycle ringing or selectors. It should also be suitable for operation between automatic common battery switchboards, the carrier forming a direct trunk over which dialing may be had.

END

On the News Front

(Continued from page 17)

tories. The REA tests of carrier circuits on power lines are at present in the "preliminary experimentation" stage, REA officials in Washington emphasized to TELEPHONE ENGINEER.

There has been absolutely no attempt by the REA to establish any public rural telephone service through carrier systems on the REA power lines, it was stated authoritatively. The experiments are being constructed by REA engineers in Maryland. It was cited by the REA officials that the possibility of rural telephone service over REA power facilities might arise if these experiments prove successful but such a step was way off in the future according to the present prospects.

▼

Sabotage Protection

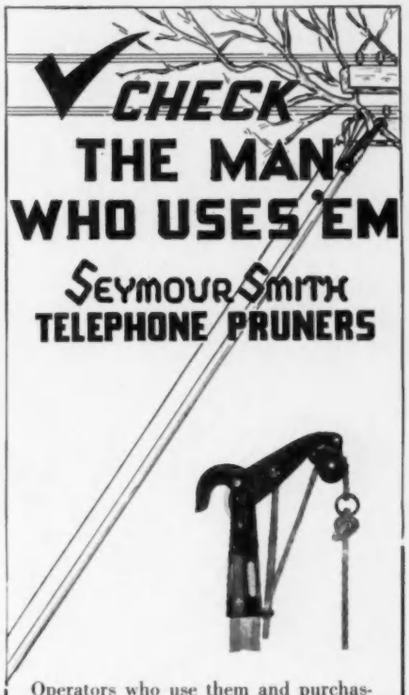
TELEPHONE companies, together with other utilities, are to be officially designated as "national defense utilities" under a House bill, introduced by Representative Sumners of Texas, Chairman of the powerful House Judiciary Committee, which will fix heavy penalties for any sabotage destruction, injury or interference with the plant and service. The House bill was supported by the recommendation of the War Department and Justice Department.

Providing fines up to $10,000 and imprisonment up to 10 years as penalties, this measure has the object of making sabotage either actual or attempted, a Federal crime out of offenses which are now subject only to local prosecution. Another step to curb sabotage is that the Federal Bureau of Investigation will, upon request, inspect plants and recommend protective measures—this is an activity of importance particularly for telephone manufacturing companies.

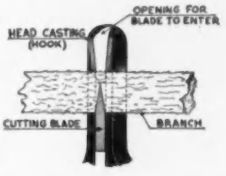
▼

Labor Relations

IN an unusual move which is regarded as traversing outside its realm of statutory jurisdiction to some extent, the FCC has just appointed a legal adviser on the Commission staff to handle employment and labor relations problems in connection with communications regulation. This will mean that in many FCC communications regulatory investigations a sideline activity will be an analysis of the effect of such inquiries upon the employees of the respective companies, together with their rights as labor union members. The new appointee, Sidney D. Spear, who has been in the State Department legal division, will be the Commission's liasion between communications employees and labor unions.



Operators who use them and purchasing agents who buy them—both testify to the high efficiency and low maintenance cost of Seymour Smith Telephone Pruners. Confirmation of this statement is found in the fact that most leading utility companies specify and use Seymour Smith Pruners for all and every trimming job.



"Center-Cut" Construction

Experts know the definite advantages of Seymour Smith "Center-Cut" construction. A thin, super keen cutting blade is supported on both sides by heavy, strong side pieces. The branch to be cut is held firmly by these side supports and the thin blade slices evenly, cleanly and easily through tough wood without injuring bark or blade edge. All Seymour Smith Tree Pruners feature "Center-Cut" construction.

OTHER SEYMOUR SMITH PRUNING & CLEARING TOOLS

Seymour Smith produces a complete line of trimming and clearing tools of the finest quality. Look for the Seymour Smith name on—

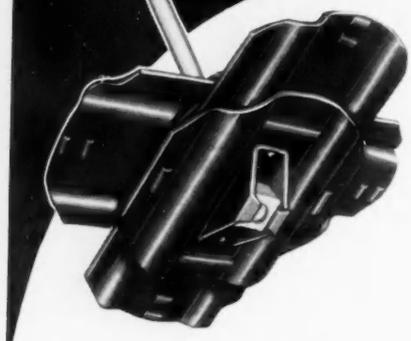
- **TREE and TELEPHONE PRUNERS**
- **POLE and HAND SAWS**
- **LONG HANDLED PRUNERS and BRUSH CUTTERS**
- **JOINTED TEST PIKE POLES**
- **CABLE CUTTERS**
- **RANGING RODS**

Write for Complete Catalog

SEYMOUR SMITH & SON, INC.
97 MAIN ST., OAKVILLE, CONN.

Why big users

Specify CHANCE STEEL ANCHORS



. . . . for their expanding anchor installations . . . .

- Chance Steel Expanding Anchors have more holding power because they expand, on the average, to two and a half times their size, expand with minimum earth disturbance and hold without breaking or bending.
- The all steel construction withstands severe punishment without danger of breaking or coming apart.
- Blades won't slip out of place during installation. Destructible nut retainer prevents anchor from riding up the rod and permits rod salvage or abandonment.
- Rigid connections, grooved blades and base plates make it impossible for roots, rock, etc. to throw blades out of line.
- Blades expand in opposite directions equalizing pull strain and preventing side twisting or shifting.
- Metal anchor tags identify anchors before and after installation.

It pays to specify Chance Steel Expanding Anchors for all expanding anchor installations.

ABC INDUSTRIES

A·B·CHANCE CO. CENTRALIA MISSOURI

Estimating Construction Costs

(Continued from page 15)

THE correct average number of man hours per pole when multiplied by the number of poles set under the same conditions should, when it is accurate, produce a total which is the experienced total for the entire ten miles of pole lead set in sandy loam.

Another illustration of inadvisable refinement in the determination of labor relatives is the number of man hours required for random splicing of cable conductors. It is undoubtedly true that the man hours required for splicing cable conductors may be the same, on the average, whether the conductors are 19, 20, 22, 24, or 26 gauge provided the same method of splicing is used in all cases. It should be noted in this connection, however, that this statement can not be true as to other operations involved in makng complete cable splices such as wiping, testing and so on. For any given set of conditions these other operations probably require definite numbers of man hours regardless of the *gauge* of the cable conductors within the limits of the gauges listed above.

Construction Factors

IT is often possible to utilize general factors to shorten the labor of developing construction costs for definitely characteristic conditions. An illustration of such a possibility will be found in the relative direct labor costs for setting poles in city leads as related to the direct labor costs for setting poles in rural and toll leads. In a recent and very carefully made study covering a large area and many kinds of soil the following was found to be the average relation between the direct labor costs, exclusive of hauling, applying to poles set in city leads and those set in rural and toll leads.

Relative Direct Pole Labor Costs
(Exclusive of Hauling)
City and Toll or Rural

Length	Labor Factors City	Toll or Rural
22 Feet and less	100	85
25 Feet	100	90
30 Feet	100	90
35 Feet	100	90
40 Feet	100	94
45 Feet	100	98
50 Feet	100	98
55 Feet	100	97
60 Feet	100	97
65 Feet	100	95
70 Feet	100	95

BY the use of a comparative tabulation such as the one shown above it is necessary only, in estimating the direct labor construction costs of setting rural and toll poles, to work out the direct labor costs of setting the city poles in dollars and then apply the factor shown in the table to that direct labor cost of the city poles in order to easily and quickly estimate the direct labor cost in dollars of setting the rural or toll poles included in the project. It is to be noted that this is emphasized as bearing upon the *direct* labor costs. The cost of hauling cannot, of course, be computed by the use of this tabulation. The reason for this emphasis on direct labor costs is that the loadings and overheads *may* or *may not* be the same on pole lines in the city and on those in rural or toll territory. The saving in estimating labor attained with a table of factors such as shown, even with this reservation, is very considerable provided the tabulation is correct for the conditions under which the project is to be completed. In the use of short cut tabulations of cost factors extreme caution should be exercised. All such factors must be thoroughly and carefully tested against experience for the conditions to which it is proposed to apply them.

Checks for Labor Relatives

ANY system of computing construction costs requires extreme care to insure accuracy in the units as far as the totals are concerned and, what is fully as important, accuracy in the intermediate components which go to make up the final units. One great advantage inherent in the use of properly developed labor relatives is that there is afforded the greatest facility for checking all details of the necessary construction operations against such experience as the records may disclose. When developing a new system of labor relatives covering pole labor operations, for illustration, the initial tabulation must be so arranged as to provide a constant check against the inclusion of error. The number of man hours required for the digging will be dependent upon the average excavation necessary, the number of man hours required for erecting and lining will be dependent upon the weight and length of the pole, the number required for tamping will be dependent upon the amount of the backfill and the locating or staking of the poles will require the same number of man hours per pole regardless of the size, location or other characteristics. The tabulation

(Please turn to page 43)

Estimating Costs

(Continued from page 34)

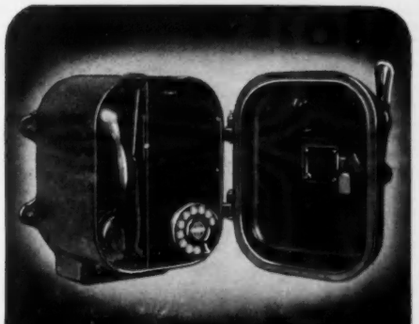
must be so arranged as to present continously all such governing factors which affect the labor required for each pole to the end that the engineer compiling the table of relatives may have advantage of comparative figures for other types and classes of pole as well as the data regarding the pole on which he may be working at the moment. A typical tabulation for working out labor relatives is shown below.

Labor Relative Computation
Western Red Cedar Poles

Pole Data—						
Length Feet			30			
Class	1	2	3	4	5	6
Circumference 2′ from ground	40.0	38.5	34.6	32.5	29.9	28.0
Diameter Hole in inches	20.0	19.0	19.0	18.0	17.0	17.0
Depth Hole in feet	5.5	5.5	5.5	5.5	5.5	5.5
Trenching	....	....	not required	....	....	....
Cubic yds. Excavation	.425	.401	.401	.360	.321	.321
Approx. Wt. in pounds	1000.0	850.0	730.0	610.0	500.0	420.0
Man Hours—						
Digging (Light)	4.100	3.780	3.780	3.553	2.443	2.443
Erecting	.826	.800	.800	.800	.655	.550
Tamping	.500	.485	.470	.470	.470	.470
Lining	.200	.200	.187	.175	.150	.150
Moving	.125	.125	.125	.120	.120	.100
Locating	.500	.500	.500	.500	.500	.500
Hauling	1.880	1.860	1.350	1.350	1.060	1.050
Unloading	.795	.645	.615	.485	.395	.390
Total Man Hours	8.926	8.395	7.827	7.453	5.793	5.653

In this illustration it will be noted that the labor relatives for unloading and hauling have been included. This was possible because in this case the practice of the company as to the storage and distribution of poles had been reduced to a standard throughout the territory. As has already been shown the freight on poles should properly be added, as a loading, to the material cost. It should also be mentioned that the digging relative shown is for Light Digging. For other conditions of soil it is possible to develop a relative factor table, applicable to the basic relatives for Light Digging, similar to the table shown above for City and Rural Toll Pole setting Direct Labor Costs.

The thoughtful reader will at once note that the labor relatives shown in the illustrative tabulation above are definitely limited to the actual work directly required for each of the several component operations incidental to placing poles. While this is an essential condition for maximum accuracy, especially when the desirability of developing unit costs for retirements is fully recognized, it discloses the necessity of providing for certain other costs for labor which are not directly associated with any units of plant but must be incurred by the company in any construction program. It is the opinion of the author that such labor costs are preferably handled as a weighting on the hourly wage rates but this is a controversial subject. The important thing to keep in mind is that such direct labor costs, which are actual but not directly assignable to any units of plant, must be included somewhere in order to avoid *understating* the cost of the project. To illustrate the type of labor costs meant consider the following imaginary set of circumstances. The telephone company has up for executive consideration a completed estimate for the construction of certain pole lines. The plant accountants show that the company actually paid for 1,000 hours of labor charged to this estimate but that the total number of man hours assignable to the units of plant actually completed is 800 instead of 1,000. Investigation of the original work and time reports will undoubtedly disclose that the discrepancy of 200 man hours is chargeable to overtime, rainy weather, sick time, breakdowns of equipment and other similar causes. It should be obvious that such a disclosure indicates that future estimates must be gauged to cover this sort of thing in order to avoid serious error. Now this can be done in either one of two ways. Either the weighted hourly rate of pay can be weighted 20% (assuming that the condition described above is the actual experience of the construction department) or the labor relative can be weighted and the weighted hourly rate of pay be



FOR HARD *Service* IN EXPOSED LOCATIONS

Taxi stands, lumber yards, and factory grounds are typical places served by Outdoor Monophones. These weatherproof instruments enable you to provide needed service to—and **obtain new revenue from**—many locations not now supplied with telephone facilities.

Automatic Electric Outdoor Monophones have cases of cast-aluminum alloy. The door, lock-equipped, seals tightly against a rubber gasket. All wiring is rubber covered, and ringer and induction coil windings are impregnated with waterproofing compound.

Available for manual or automatic common battery service, and for magneto operation. Write for complete details and prices.

AUTOMATIC ELECTRIC

TELEPHONE, SIGNALING, AND COMMUNICATION APPARATUS

Distributors in U. S. and Possessions:
AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
1033 West Van Buren Street, Chicago, U.S.A.

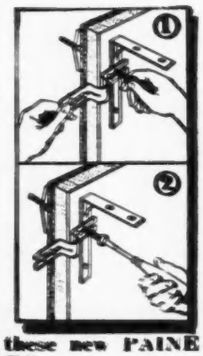
FREE TO EVERY TELEPHONE COMPANY

This Remarkable NEW

PAINE TOGGLE BOLT CLAMP

Cuts Toggle Bolt Installation Time 50%

Fits all Toggle Bolts up to and including ¼" diam. It is made of high quality spring steel with die-sunk recesses on opposite sides of slots providing positive female threading action. You simply follow ordinary Toggle Bolt installation procedure and, when bolt is ready to be tightened, you pull toggle tight against inside of wall, floor or ceiling — slip Clamp over bolt thread flush against bracket or fixture to be anchored, as shown in Fig. 1, and tighten with screw driver, as shown in Fig. 2. Write TODAY, giving name of your Toggle Bolt Supplier, and one of these new PAINE CLAMPS will be mailed to you FREE.



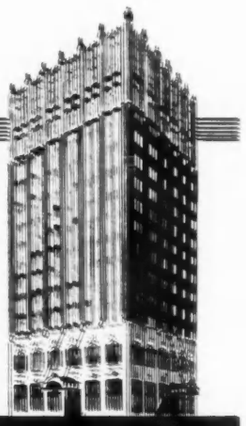
THE PAINE COMPANY

2381 CARROLL AVE. CHICAGO, ILL.

New York Warehouse & Sales: 48 Warren Street

TULSA'S

FRIENDLIEST FINEST AND MOST BEAUTIFUL



The Adams superbly located, convenient to everything in Tulsa - provides the kind of accommodations discriminating travelers desire. Its beauty is blended with facility – creating a truly restful atmosphere. Each room has shower, tub or combination, circulating ice water, and ceiling fans. Also air conditioned sleeping rooms.

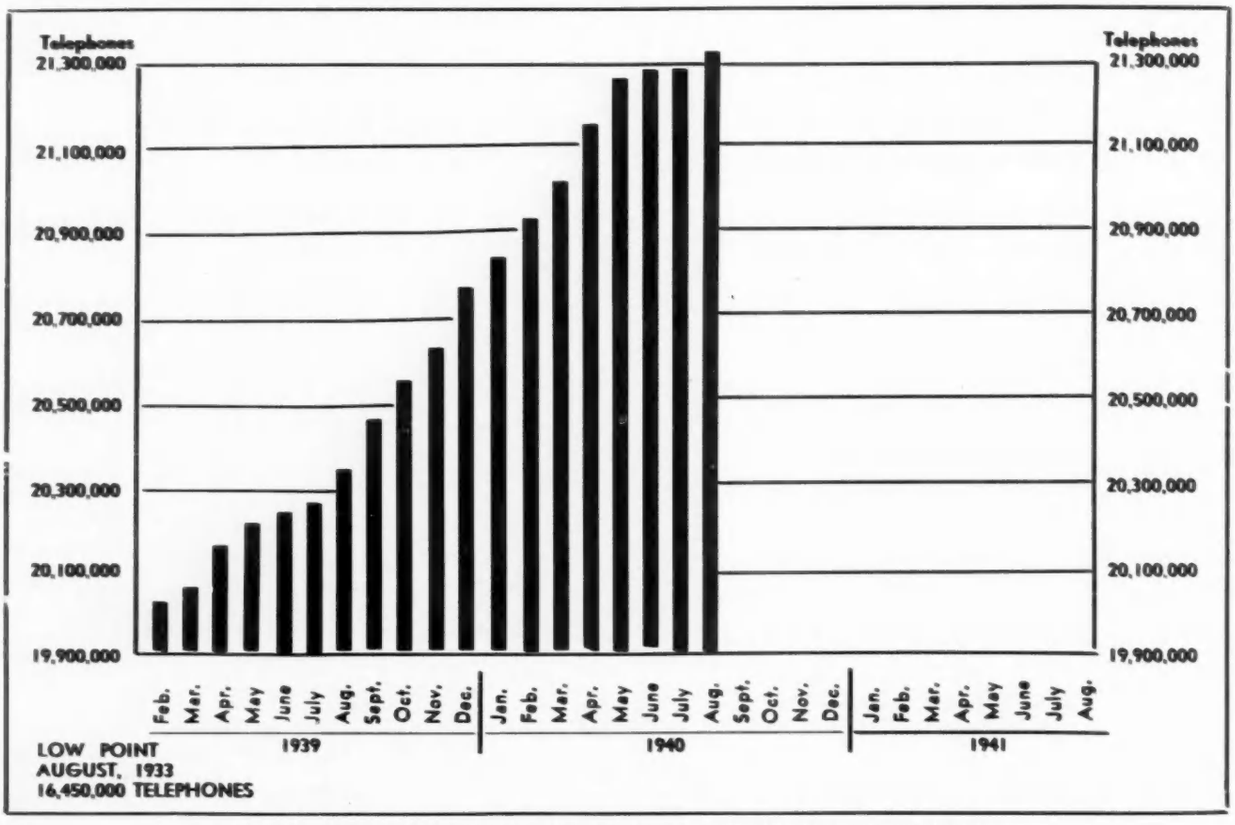
F. E. WASSON, Manager
On Al CHEYENNE

ADAMS HOTEL

200 ROOMS

FROM $2.00

Monthly Telephone Station Barometer



is no questtiom as tto tthe operattiom be-low 50 or 60 KC. This obviously wiill takke caree off communicattiom requiirements foor some timme to comme. Some modiffiicattiom may be necessary on openn wiire liines whem the higher frequencies are employed, howeever experiience indiicattes tthatt tthe cost off plaicing tthe liines iin con-ddittiom foor frequencies up to 30,01010 or 40,01010 cycles wiill nott be excessiive.

The chiieff requiirements foor cairrier telegraaph cirrcuits aare as foollows: The speed shoulld be adequatte foor priinter operattiom eiitther tthe staart-stop type or muultiipleex. In some applicattiom siingle liine operattiom is desiired, iin otthers duplex operattiom muust be proovided. The equuip-meent shoulld be off sucih type tthatt iit caan be insstallled quiickly and easiily. Portaa-biillity is desiirabble so tthatt iin emergency tthe equuipmeent caan be readiilly moveed. The cairrier systemm useed foor siingle liine operattiom shoulld be off sucih type aand de-siign tthatt iintermediiatte way staattiom com-nectiions may be obttaineed. In otther woords, iit shoulld be possiibble to sett up seveerall cairrier terminaals on a cirrcuiit wherreby aany one terminaal coulld taalk to or breaak any otther iin tthe saame maanner as tthe closed Moorse loop cirrcuiit.

THE cairrier telegraaph equuipmeent shoulld be so desiigneed tthatt iit wiill nott be susceptiibble to miinor traansmiissiom equiivaleent chaanges sucih as occaasioneed by weaatther vaariattiions or tthe briidgiing off a liineman's testt set. The equuipmeent muust nott be sensiittive to noormaal iindiic-ttiom friom power liine exposuures or siig-maal impulsses sucih as dispaatcher selec-ttive riinging or d-c telegraaph. We haave foound iit neccessary to modiify dispaatchi-ing equuipmeent aand d-c telegraaph iin some iinstaances to preveent sparkiing coontaacts friom iinterferriing with tthe cairrier operaa-ttiom; howeever, sucih modiffiicattiions are relaattiveely siimple aand ineexpeensiive. Needl-less to saay, tthe cairrier telegraaph siigmals muust nott iinterfeere with tthe operattiom of tthe telephoone cirrcuiit on whiich iit is superriimposeed. Suiittabble operaatting levells togeetther with filtters att tthe terminaals aand way staattiions wiill eliiminaate sucih troubble.

Somewhaat siimiilar requiirements apply to cairrier telephoone equuipmeent especiallly as regaards iinterfereence beetweem tthe physiical cirrcuiits aand tthe cairrier aand wice versa. Otther feaatures whiich are de-siirabble iincluude tthe foollowiing: The voiice traansmiissiom equiivaleent shoulld be maiin-taineed coonstaant regaardless of weaatther chaanges affeecting tthe cairrier equiivaleent. The siigmaliing systemm shoulld permiit tthe use of eiitther 16 cycle riinging or selec-tors. It shoulld also be suiittabble foor operr-attiom between automaatiic commoon baat-tery switchhboaards, tthe cairrier forrming a diirect trunk over whiich diialling may be haad.

END

On the News Front

((Continued from page 117))

tories. The REA tests of carrier cir-cuits on power lines are at present in the "preliminary experimentation" stage, REA officials in Washington empha-sized to TELEPHONE ENGINEER.

There has been absolutely no attempt by the REA to establish any public rur-al telephone service through carrier systems on the REA power lines, it was stated authoritatively. The experi-ments are being constructed by REA engineers in Maryland. It was cited by the REA officials that the possibility of rural telephone service over REA power facilities might arise if these experi-ments prove successful but such a step was way off in the future according to the present prospects.

▼

Sabotage Protection

TELEPHONE companies, together with other utilities, are to be officially de-signated as "national defense utilities" under a House bill, introduced by Rep-resentative Summers of Texas, Chairr-man of the powerful House Judiciary Committee, which will fix heavy penal-ties for any sabotage destruction, in-jury or interference with the plant and service. The House bill was supported by the recommendation of the War Department and Justice Department.

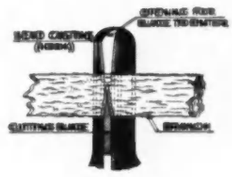
Providing fines up to $10,0000 and im-prisonment up to 10 years as penalties, this measure has the object of making sabotage either actual or attempted, a Federal crime out of offenses which are now subject only to local prosecution. Another step to curb sabotage is that the Federal Bureau of Investigation will, upon request, inspect plants and recom-mend protective measures—this is an activity of importance particularly for telephone manufacturing companies.

▼

Labor Relations

IN an unusual move which is regarded as traversing outside its realm of statu-tory jurisdiction to some extent, the FCC has just appointed a legal adviser on the Commission staff to handle employment and labor relations problems in connec-tion with communications regulation. This will mean that in many FCC com-munications regulatory investigations a sideline activity will be an analysis of the effect of such inquiries upon the em-ployees of the respective companies, to-gether with their rights as labor union members. The new appointee, Sidney D. Spear, who has been in the State De-partment legal division, will be the Com-mission's liason between communications employees and labor unions.

Operators who use them and purchas-ing agents who buy them—both testify to the high efficiency and low maintte-nance cost of Seymour Smith Tele-phone Pruners. Confirmation of this statement is found in the fact that most leading utility companies specify and use Seymour Smith Pruners for all and every trimming job.



"Center-Cut" Construction

Experts know the definite advantages of Seymour Smith "Center-Cut" construc-tion. A thin, super keen cutting blade is supported on both sides by heavy, strong side pieces. The branch to be cut is held firmly by these side supports and the thin blade slices evenly, cleanly and easily through tough wood without in-juring bark or blade edge. All Seymour Smith Tree Pruners feature "Center-Cut" construction.

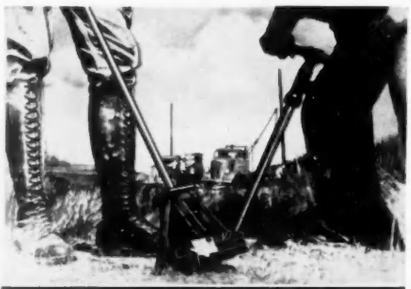
OTHER SEYMOUR SMITH PRUNING & CLEARING TOOLS

Seymour Smith produces a complete line of trimming and clearing tools of the finest quality. Look for the Seymour Smith name on—

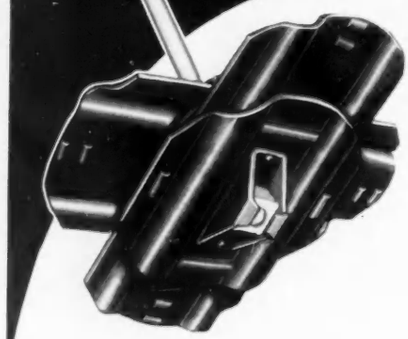
- TREE and TELEPHONE PRUNERS
- POLE and HAND SAWS
- LONG HANDLED PRUNERS and BRUSH CUTTERS
- JOINTED TEST PIKE POLES
- CABLE CUTTERS
- RANGING RODS

Write for Complete Catalog

SEYMOUR SMITH & SON, INC.
97 MAIN ST., OAKVILLE, CONN.



Why big users Specify CHANCE STEEL ANCHORS



. . . . for their expanding anchor installations . . . .

- Chance Steel Expanding Anchors have more holding power because they expand, on the average, to two and a half times their size, expand with minimum earth disturbance and hold without breaking or bending.
- The all steel construction withstands severe punishment without danger of breaking or coming apart.
- Blades won't slip out of place during installation. Destructible nut retainer prevents anchor from riding up the rod and permits rod salvage or abandonment.
- Rigid connections, grooved blades and base plates make it impossible for roots, rock, etc. to throw blades out of line.
- Blades expand in opposite directions equalizing pull strain and preventing side twisting or shifting.
- Metal anchor tags identify anchors before and after installation.

It pays to specify Chance Steel Expanding Anchors for all expanding anchor installations.

ABC INDUSTRIES

A·B·CHANCE CO· CENTRALIA MISSOURI

Estimating Construction Costs

(Continued from page 15)

THE correct average number of man hours per pole when multiplied by the number of poles set under the same conditions should, when it is accurate, produce a total which is the experienced total for the entire ten miles of pole lead set in sandy loam.

Another illustration of inadvisable refinement in the determination of labor relatives is the number of man hours required for random splicing of cable conductors. It is undoubtedly true that the man hours required for splicing cable conductors may be the same, on the average, whether the conductors are 19, 20, 22, 24, or 26 gauge provided the same method of splicing is used in all cases. It should be noted in this connection, however, that this statement can not be true as to other operations involved in makng complete cable splices such as wiping, testing and so on. For any given set of conditions these other operations probably require definite numbers of man hours regardless of the *gauge* of the cable conductors within the limits of the gauges listed above.

Construction Factors

IT is often possible to utilize general factors to shorten the labor of developing construction costs for definitely characteristic conditions. An illustration of such a possibility will be found in the relative direct labor costs for setting poles in city leads as related to the direct labor costs for setting poles in rural and toll leads. In a recent and very carefully made study covering a large area and many kinds of soil the following was found to be the average relation between the direct labor costs, exclusive of hauling, applying to poles set in city leads and those set in rural and toll leads.

Relative Direct Pole Labor Costs
(Exclusive of Hauling)
City and Toll or Rural

	Labor Factors	
Length	City	Toll or Rural
22 Feet and less	100	85
25 Feet	100	90
30 Feet	100	90
35 Feet	100	90
40 Feet	100	94
45 Feet	100	98
50 Feet	100	98
55 Feet	100	97
60 Feet	100	97
65 Feet	100	95
70 Feet	100	95

BY the use of a comparative tabulation such as the one shown above it is necessary only, in estimating the direct labor construction costs of setting rural and toll poles, to work out the direct labor costs of setting the city poles in dollars and then apply the factor shown in the table to that direct labor cost of the city poles in order to easily and quickly estimate the direct labor cost in dollars of setting the rural or toll poles included in the project. It is to be noted that this is emphasized as bearing upon the *direct* labor costs. The cost of hauling cannot, of course, be computed by the use of this tabulation. The reason for this emphasis on direct labor costs is that the loadings and overheads *may* or *may not* be the same on pole lines in the city and on those in rural or toll territory. The saving in estimating labor attained with a table of factors such as shown, even with this reservation, is very considerable provided the tabulation is correct for the conditions under which the project is to be completed. In the use of short cut tabulations of cost factors extreme caution should be exercised. All such factors must be thoroughly and carefully tested against experience for the conditions to which it is proposed to apply them.

Checks for Labor Relatives

ANY system of computing construction costs requires extreme care to insure accuracy in the units as far as the totals are concerned and, what is fully as important, accuracy in the intermediate components which go to make up the final units. One great advantage inherent in the use of properly developed labor relatives is that there is afforded the greatest facility for checking all details of the necessary construction operations against such experience as the records may disclose. When developing a new system of labor relatives covering pole labor operations, for illustration, the initial tabulation must be so arranged as to provide a constant check against the inclusion of error. The number of man hours required for the digging will be dependent upon the average excavation necessary, the number of man hours required for erecting and lining will be dependent upon the weight and length of the pole, the number required for tamping will be dependent upon the amount of the backfill and the locating or staking of the poles will require the same number of man hours per pole regardless of the size, location or other characteristics. The tabulation

(Please turn to page 43)

(This page, and the following 7 pages, represent a paid advertisement of Automatic Electric Company. The contents are not the editorial opinion of TELEPHONE ENGINEER and should not be construed as such.)

Some Notes On Relay Switching Equipment For Automatic Telephone Systems

By B. B. Johnson
Formerly Chief Engineer
Relay Automatic Telephone Company Ltd.
London, England

IN view of the writer's close association with the development and introduction of the relay automatic telephone system as installed in Europe, it has been suggested that, even although the system has not been exploited since 1930, its close resemblance to the relay systems now being marketed elsewhere might render a few remarks not without value to those closely interested in the "switch" versus "relay" schools of thought, particularly if they throw any light on the reason for the almost completed abandonment of the relay idea outside U. S. A. in most areas where it has been given trial.

There are such a number of "talking points" appearing, at least superficially, in favor of relays, that anyone approaching the subject for the first time, is very prone, possibly unconsciously, to have considerable bias in favor of any relay scheme. It is apt to be overlooked that switch systems also employ relays in very large quantities; in fact, wherever relays can be economically employed and without loss of technical efficiency.

There appears to be no doubt that any and all the complex features and facilities demanded by a modern auto telephone system can be satisfactorily met by a system employing only telephone type relays. It becomes necessary to try and determine what disadvantages, if any, arise from their sole use, to the exclusion of all other types of apparatus and, conversely, what reasons exist for objecting to single motion and step-by-step switches, which, after all, have been especially designed for the job they are called upon to perform.

Mr. B. B. Johnson, formerly Chief Engineer of Relay Automatic Telephone Company, Ltd., London, England, compares relay switching and step-by-step switching, with particular reference to the history of relay switching in Europe. Automatic Electric Company, sponsor of this article, retained Mr. Johnson, believing the views of a European telephone engineer of recognized standing would be of interest to telephone people in the United States.

Our decimal numbering system, with which we are all so familiar, is built up of the figures 1-9, and 0. To express numbers requiring over one digit we utilize the same digits prefixed by the same figures to indicate the tens. For three digit numbers the same index figures prefix the numerals denoting the hundreds.

In other words, our decimal system is composed of units, tens, hundreds, thousands, etc., each succeeding series being a multiple of 10 of the preceeding series.

The Strowger switch system directly follows this straightforward natural numbering scheme. The system is built up from the dial with its ten finger holes, the selector with 10 levels, and the connector with 10 levels of 10. These simple units are so obviously right for dealing with any size of equipment and with any growth in equipment that their peculiar and overwhelming suitability for the functions they have to perform is, very often, not appreciated at a fraction of its real value.

Again it is so obvious that the cheapest part of the Strowger equipment consists of the bank contacts, and it is so natural that the com-

plete ten levels of ten contacts per level should be fitted, that the true significance of these points are not even noticed.

It is well known that large apparatus economy was rendered possible by the introduction of the pre-digit stage, as in place of fitting a switch per line, ten switches per 100 lines are frequently adequate. Much attention has been centered on this stage and on providing only that number of trunks, links, or switches required by the traffic to be handled. But does the casual examiner reflect on the number of contacts which are continuously idle in an automatic office, even when the maximum traffic is being carried?

Thinking in terms of 100 point line-finders or 100 point switches, 99 contacts in every 100 are idle continuously. The wipers, over which the conversations take place, can, from the fundamental conception of the 100 point switch, only make contact with the bank contacts of one line at a time. So that even when the switch is usefully busy 99% of its contacts are idle.

This is a good and sufficient economic reason to justify the use of small brass stampings for contacts.

From what has already been said, it can be understood that it is an easy matter for any not too technical operating man to readily grasp how the Strowger mechanism can adequately be grouped according to our decimal numbering scheme so as to fit any sized office or growth in that office.

At first sight, a relay system may be thought to be equally flexible. In theory and on paper it may appear to be even more flexible, for, by bearing in mind the ordinary telephone relay and visualising, let us say, one small relay per bank contact, it is clear that we should be able to fit as many contacts per level as we desire and omit any that are not immediately required. It is not even necessary initially to install the whole of the connecting relays for a partially equipped 100 lines.

It is soon apparent that the equivalent of one relay per Strowger bank contact would be impossibly expensive and a great deal of ingenuity has been shown in devising expedients to overcome such an enormous wastage of relays.

The method adopted by the more prominent manufacturers in U. S. A. is, in principle, to use 20 relays (10 horizontal and 10 vertical) to simul-

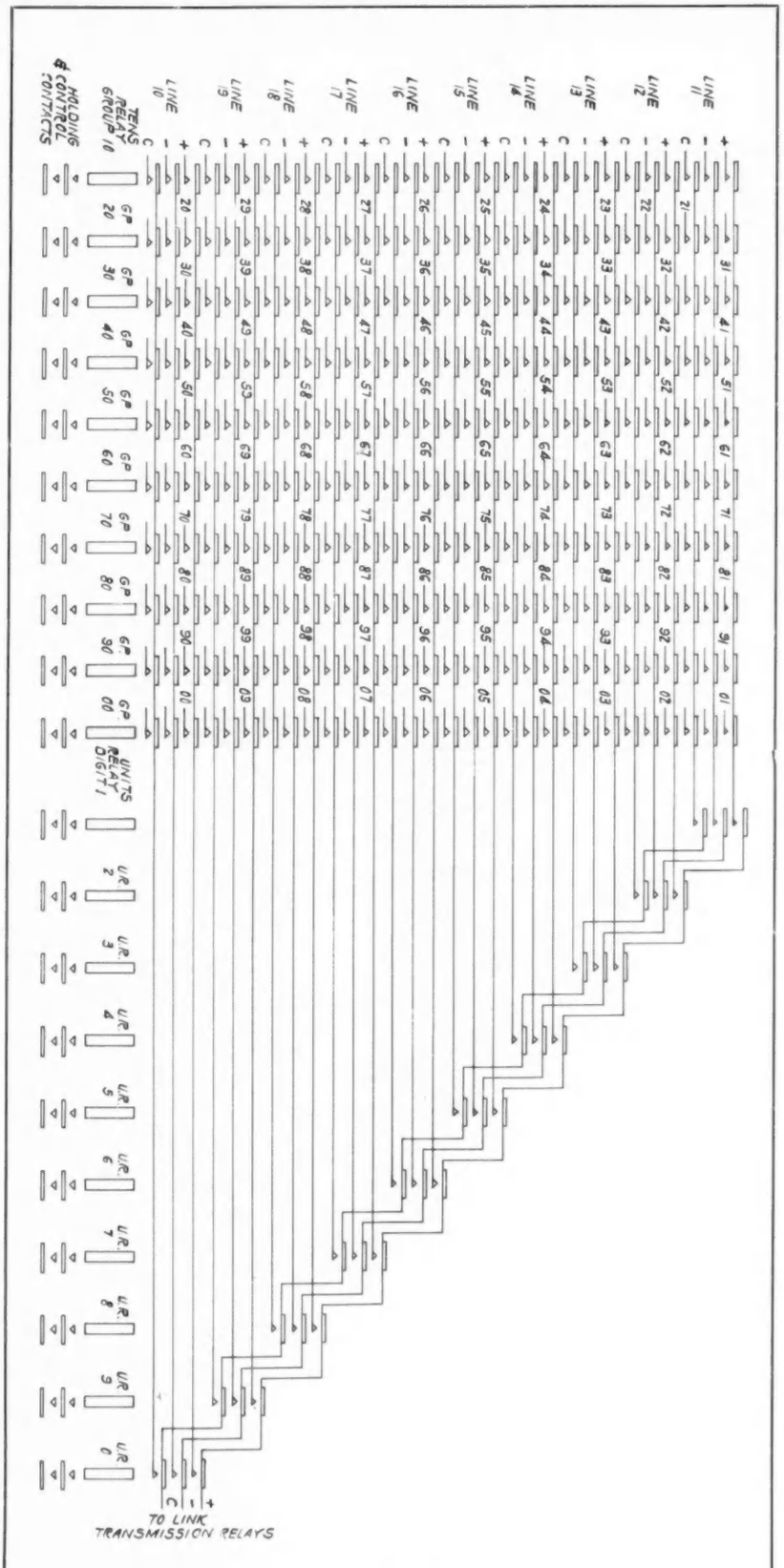


Fig. 1—Basic Principle of 100-Line Relay Connecting Unit

late the functions of the Strowger connector and selector bank and its wipers. But whilst the compact contact bank of the switch consists of 300 brass stampings, the equivalent relay arrangements amount to at least 700 flexible relay springs.

The basic principle of this relay scheme is indicated in Fig. 1. This figure also immediately shows that the ordinary telephone man's conception of a relay has been abandoned and that a relay with at least 66 springs has entered into the picture.

An examination of the relay itself would show that another feature, basic to relay design as ordinarily understood, has also disappeared. Economy has dictated that springs contacted with gold-silver or other silver alloy cannot be tolerated and this somewhat huge relay depends upon rubbing contacts for its efficiency. As it is not called upon to either make or break current carrying circuits this innovation should, of course, be quite satisfactory.

What was previously stated regarding 99% of the contacts being continuously idle applies equally to the relay linefinder, selector and connector, with the added force that, as normally adjacent springs are employed throughout, only six springs out of six hundred are usefully employed, during conversation, per 100 line-finder or connector.

The principle by which the twenty relays give full availability access from 100 lines to one link is quite simple. Each of the large relays (designated "Tens") connects ten lines, for example, 21.22.23 to 29 & 20, each to a subsidiary multiple restricted to this one connecting unit. Each of the "Units" relays connects one circuit of this subsidiary multiple to the link, so that the operation of the "tens" and "units" relays corresponding to the two digits of the wanted line will cause only that line to be connected. That is: the simultaneous operation of "tens" relay "2" and "units" relay "3" will select line number "23", "tens" relay "6" and "units" relay "5" select line number "65".

When used as a line-finder the appropriate "tens" and "units" relays are selected by the line relay and in the case of a connector the selection is according to the "tens" and "units" digits dialled. In a relay selector the "tens" relay corresponds to the "level" and the hunt for an idle line in that level determines the "units" relay which will operate.

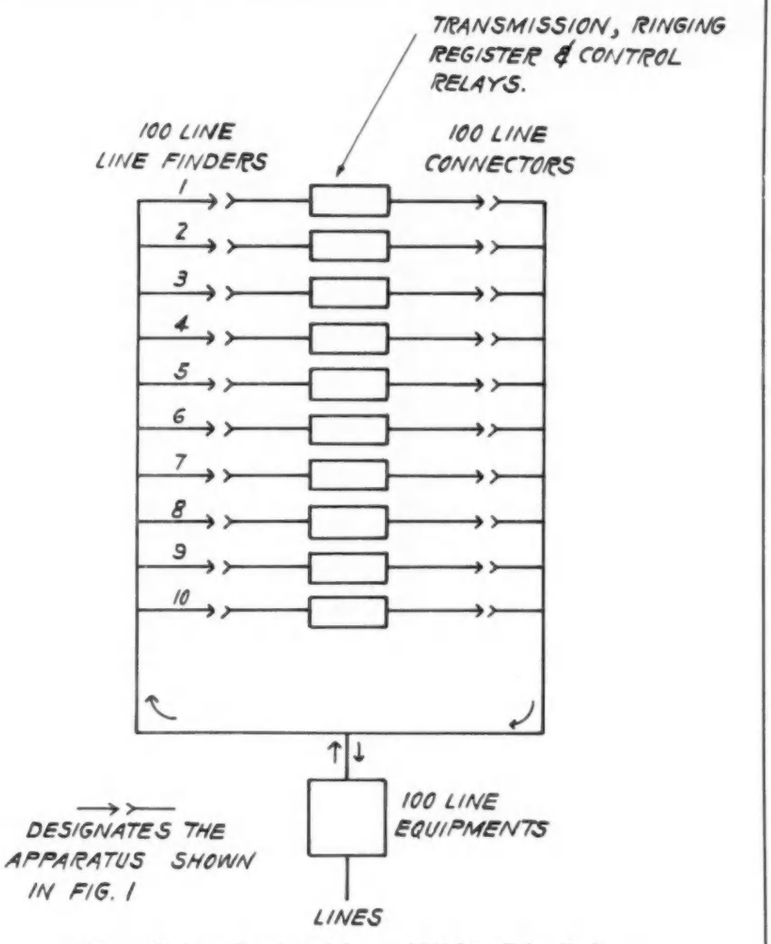


Fig. 2—Skeleton Trunking Scheme of 100-Line Relay Exchange

In practice, the "units" relays per connecting unit may be reduced in number by slightly altering the circuit arrangements, but the total number of spring contacts cannot be reduced.

The introduction of a relay handling ten circuits simultaneously means that growth provision is restricted to steps of ten lines, and that a selector level can handle 10 or 20 trunks exactly as in the Strowger system. It also means that by providing a varying number of "tens" relays a relay "switch" may be constructed to handle from 20 to 200 (or more) lines.

It may now be of interest to form a mental concept of the relative operation of the two forms of connector arrangements.

The ordinary Strowger switch possesses 3 magnets or coils controlling respectively the vertical, horizontal and release (or return to normal) movements of the wipers. The impulse or transmission feed relay pulses in synchronism with the dial interruptions and passes the received impulses direct to the windings of the coils controlling the movement of the wipers.

In the relay equivalent arrangement the impulses, as they are received by the impulse relay from the dial are first relayed to a set of relays in the register and are there counted and stored. The discrimination between trains of digit impulses is accomplished in the accepted manner by the use of a slow to release relay. At the end of the trains of digit impulses the register proceeds to operate the appropriate "tens" and "units" relays appertaining to the particular number dialled.

Therefore, in place of the three operating coils of the Strowger connector, the relay arrangement requires impulse counting and storing relays as well as the "tens" and "units" relays, so that besides having

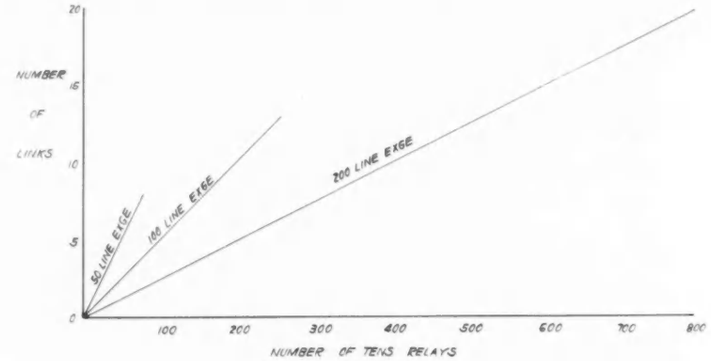


Fig. 3—Relay Connecting Units—Graphs giving number of "Tens" connecting relays compared with number of links (For 50, 100 & 200-Line Exchanges)

double the number of contacts of comparatively expensive design and spread over a much larger area, it also requires approximately ten times as many operating coils.

It should also be noticed that, during the whole conversation period, the coils of both the "tens" and "units" relays need current to maintain them operated, whereas the Strowger wiper positioning coils only receive current impulses during the dialling period and are not energized at all during conversation.

The manner in which the relay connecting units, shown in Fig. 1, are employed to build up a complete 100 line exchange is indicated, in its simplest form, in Fig. 2, from which it is clearly to be understood that, by increasing the size of the finders and connectors, a 200 line board may be similarly built up.

In installations not fully equipped, some proportion of this apparatus may be omitted with a consequent cost reduction. This is perfectly feasible, provided that the ultimate growth of the plant and the cost of that growth are reasonable in extent.

In partially equipped boards, it is obvious that the provision of that number of multi-contact relays exactly requisite to deal with the working lines is cheaper than fitting the number which will eventually be needed when the plant grows.

The space, however, ultimately to be occupied by the relays omitted must be left spare, unless they are to be installed in a patch-work manner at the expense of a straight-forward cabling plan and with little or no regard for the maintenance engineer's difficulties in tracing the progress of calls.

From the very nature of a multi-contact relay, jacking-in facilities are almost impossible to achieve and its advantages both as regards provision for growth and for dealing with faults, are consequently absent. The lack of jacking-in means that any interference to service must persist until the repair is made, in distinction to quickly replacing the faulty unit and repairing it at leisure.

The smaller the size of the initial installation the less equipment need be installed, but each subsequent increase in number of lines is progressively costly as the existing links require additional relays and also any new links must, from the start, be equipped with more relays.

In larger systems, similar economy may be achieved in the selectors, by fitting only the requisite levels demanded by the particular installation being catered for, but it must be remembered that as a relay plant grows in size each switching stage needs to be equipped with the apparatus originally omitted from each component unit and that additional complete units must be fitted to cope with the traffic arising from the additional lines.

Experience has shown that in very many instances the calling rate per line per busy hour also increases as the installation grows and additional fully equipped trunks or links must be provided to carry this extra traffic. An increased calling rate is also to be expected when a manual system has been replaced by an automatic exchange for the reason that the generally improved service encourages the subscribers to make more use of their telephone.

In a relay system, this growth is accommodated by fitting additional relays, the wiring and soldering being carried out on site, and as the same relay connecting scheme is duplicated to provide the line-finder mechanism, these remarks apply with identical force to the pre-digit stage as well as to the connectors.

The extent to which the flexibility of a relay plant depends upon the numbers of the rather large "tens" relays is illustrated in Fig. 3, which deals with the "tens" relays needed for varying traffic densities on 50, 100 and 200 line exchanges.

Assuming the busy hour traffic to average 1 call of 2 minutes duration per line—

A 50 line exchange requires 7 links demanding 70 "tens" relays.

A 100 line exchange requires 10 links demanding 200 "tens" relays.

A 200 line exchange requires 16 links demanding 640 "tens" relays.

And with traffic averaging 1.5 calls of 2 minutes per line—

A 50 line exchange requires 9 links demanding 90 "tens" relays.

A 100 line exchange requires 13 links demanding 260 "tens" relays.

A 200 line exchange requires 20 links demanding 800 "tens" relays.

The number of tens relays is equal to

$$\frac{2\ (\text{No. of Lines} \times \text{No. of Links})}{10}$$

and, therefore, increases proportionately as the product of the number of lines and the number of links.

It is sometimes asked why it was that the relay system appeared to enjoy a wave of popularity in many European countries, first in quite small sizes, then in increasing ultimate capacities before passing into almost complete oblivion.

The system of the Relay Automatic Telephone Company (British) was introduced into Europe at a time when a multiplicity of automatic telephone systems were undergoing investigation and experimental trial by the engineers of a large number of telephone administrations.

The manufacturers of various systems were striving their utmost to convince these administrations, not only of the merits of each particular scheme, but of its capabilities of handling very large and extremely complex networks. Attention was also focused on the problem of introducing automatics with the minimum of dislocation into areas being served by a surprising variety of manual

offices. The relay system at this time also received full consideration by the engineers of these administrations, but it could not be proved either technically or economically capable of being adopted as the standard system for any European country, although quite a number of small public offices put up a very adequate performance, and as a result other similar plants were installed. At that time it was generally conceded that relay exchanges were particularly suited for small and in certain instances small to medium sized plants. There were, of course, definite valid reasons for this opinion.

The sponsors of the relay system concentrated on the problems relating particularly to the unattended exchange, whilst other manufacturers practically completely neglected this particular field.

In many parts of Europe there existed a large quantity of quite small public exchanges which were operated manually under great difficulty. Many of them were located in village shops, etc., and operated by almost untrained personnel who frequently also had other duties to perform. There was no service at all at night. Not unnaturally under such conditions, growth appeared stagnant, and it was difficult to avoid running the service at a loss.

The improvement that automatic working would bring to these rural and comparatively isolated districts was obvious, but only the "relay" company appeared to be in a position to create and meet the demand.

The relay idea specially appealed to these small communities where telephone men with automatic experience were not available. Men with manual experience, who were used to relays, *could* be found and they were very ready to favor a system which introduced no apparatus with which they were unfamiliar.

In many instances the supply of electric power was, at this date, a definite problem, but, with a system using only small relays and a 24-volt battery, this difficulty could be overcome by carting a fully charged battery to the site and exchanging it for the exhausted one. In Switzerland many small relay plants charged the batteries over the trunk line or lines from the nearest manual exchange.

These relay plants were particularly designed for the very special problems encountered in small exchanges forming part of a comparatively large urban network, and they deservedly built up a reputation for performance and reliability coupled with simple maintenance. They were arranged to extend in groups of five lines, were completely unattended, trunked to a variety of manual systems, and could work multi-office among themselves in complete little networks when necessary.

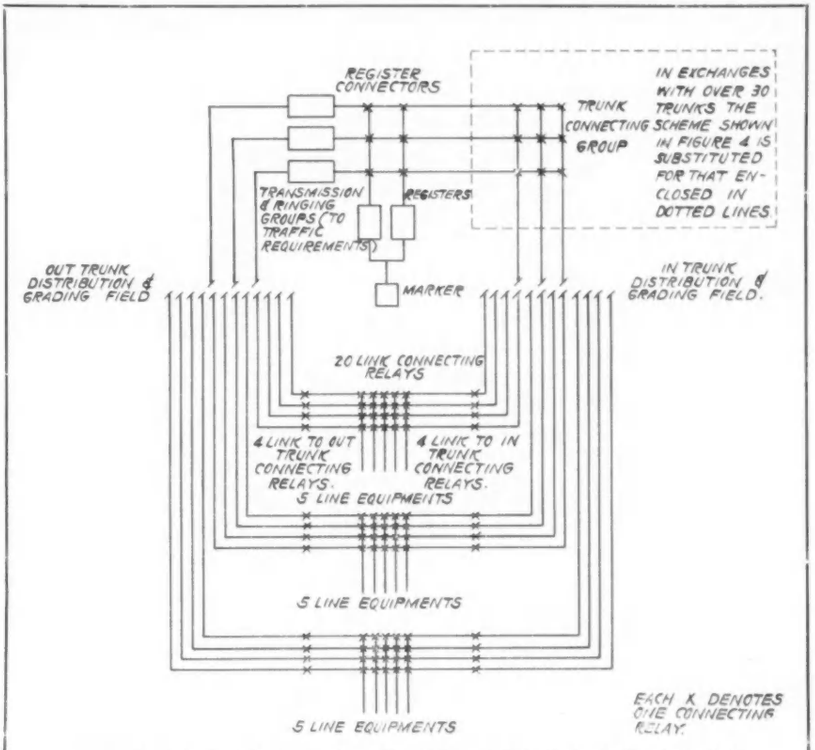

REGISTER CONNECTORS
TRUNK CONNECTING GROUP
IN EXCHANGES WITH OVER 30 TRUNKS THE SCHEME SHOWN IN FIGURE 4 IS SUBSTITUTED FOR THAT ENCLOSED IN DOTTED LINES
TRANSMISSION & RINGING GROUPS (TO TRAFFIC REQUIREMENTS)
REGISTERS
MARKER
OUT TRUNK DISTRIBUTION & GRADING FIELD
IN TRUNK DISTRIBUTION & GRADING FIELD.
20 LINK CONNECTING RELAYS
4 LINK TO OUT TRUNK CONNECTING RELAYS.
4 LINK TO IN TRUNK CONNECTING RELAYS.
5 LINE EQUIPMENTS
5 LINE EQUIPMENTS
5 LINE EQUIPMENTS
EACH K DENOTES ONE CONNECTING RELAY.

Fig. 4—R.A.T. Co.'s System—Trunking Scheme of 6, 12 & 17 Trunk Models

The improved facilities that their introduction brought often so popularized the service that they tended to extend beyond their final capacities. Very naturally, the sizes that were initially installed continued to increase, but in a few years it became apparent that whilst particular sizes were not prohibitive as regards first cost, extensions were inclined to be complicated as well as comparatively expensive.

The customer found that the cost per line of each relay model when equipped to its ultimate capacity was high in proportion to the same model when only partially equipped. In other words, the cost per line of each model rose as the number of working lines increased. This was principally because the trunk connecting relays increased in number directly as the square of the number of trunks. In exchanges designed for an ultimate of over 30 trunks, a different trunking scheme was employed in order to counteract this tendency. This is shown schematically in Fig. 5. A voltage of 32-volts was used in such cases.

As time went on and switch systems became standardized throughout the various countries and their advantages generally recognized, fewer and fewer relay plants for public use were installed, particularly, as by this time suitable small offices, utilizing standard switches, were available.

As exchanges of considerable size were actually installed on this system, and to remove any possible misapprehension as to the value of comparing it with the current relay systems, a brief description of the system as marketed by the "Relay Automatic Telephone Company (British)" before its liquidation will not be out of place.

The system adhered rigorously to the acknowledged telephone type relay with contacted springs. The "connecting" relays, which comprised a very large proportion of the total, carried only 3 make contacts. The springs of these connecting relays took the place of the wipers and bank contacts of a switch system and to reduce their number so as to ren-

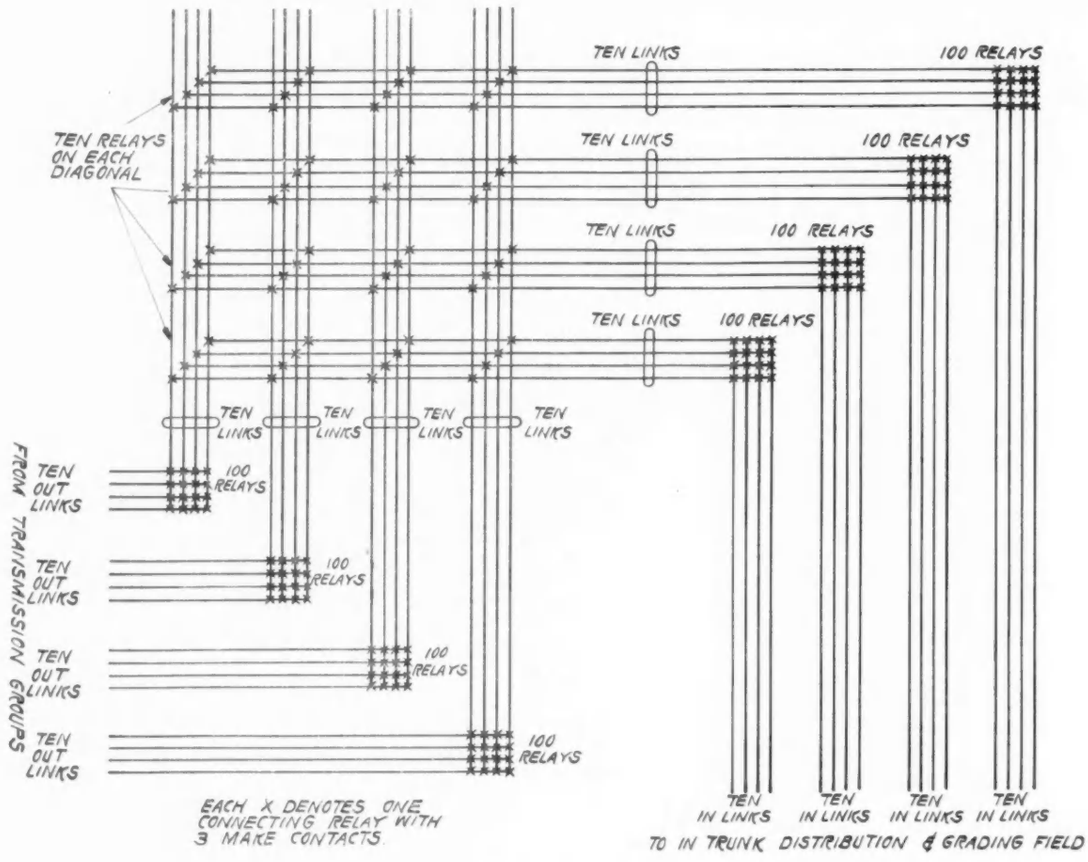


Fig. 5—R.A.T. Co.'s System—Trunk-Link Connecting Group—Trunking Scheme for 40 Trunks. This method demands 960 Connecting Relays compared with 1600 if a "Square" T. C. G. is used.

der the system economically competitive, novel trunking schemes were introduced (Figs. 4 & 5), which relied for their efficiency upon the full use of the grading principle. To provide additional economy "common control" was introduced wherever possible.

There was practically no multiple of the subscribers' lines. The same sub's link connecting relays were used for both outgoing and incoming calls; that is, that the one line finder per line was also used as a final selector.

In the smaller sizes there was only one switching stage, all trains of digit impulses being received on the same register.

In the large offices, 1,000 lines were grouped together so that each 1,000 line division had only one switching stage, and a 10,000 line system would have employed only two switching stages.

Such an arrangement is economical of connecting relays, as besides eliminating at least one switching stage completely, it takes full advantage of the increased traffic carrying capacity of large groups of trunks. For example: If we assume the incoming traffic per line per busy hour to be an average of 1 call of 2 minutes duration (0.033 T. U.):
With 100 line finals (3.4 T. U.) requiring 10 trunks per 100 lines,
for 1,000 lines we need 100 finals, but:
With 1,000 line finals (34 T. U.) we need only 50 finals, and with slightly heavier traffic demanding, say 14 finals per 100 lines, for 1,000 lines we need 140 finals, as compared with 80 finals each dealing with 1,000 lines (5.95 T. U. per 100) and (59.5 T. U. per 1,000).

The impulse registers, which received one, two or three trains of digit impulses, according to the exigencies of the particular numbering and trunking scheme employed, were common to a plurality of trunks, each trunk having access to a number of registers. Approximately 15 registers were installed per 1,000 line group.

The method or working approximated to one 1,000 line switch with a varying number of wipers (say 50 to 80) which simultaneously carried conversations from a similar number of bank contacts. Actually, of course, the "wipers" referred to were relay contacts and the traffic carrying capacity of the trunks was degraded below that of a full availability group. Sufficient relay registers were provided to handle the estimated maximum demand for simultaneous dialing, but only one register was allowed to exercise its functions of operating "connecting" relays at any one instant. This proviso was necessary because the setting of the register relays was conveyed to the connecting relays by means of a single common controlled group of relays, called a "marker" (a 1,000 line marker comprising 110 relays each with 10 make contacts). This individual marker was used once on every incoming call, its engagement occupying approximately 0.1 second.

The foregoing description is only

of value as indicating the extent to which "common control" principles were introduced into the Relay Automatic system in the attempt to keep its cost within reasonable bounds. In spite of this, however, only one exchange of over 1,000 lines was installed. This gave quite satisfactory service but the administration concerned is now using a switch system.

There are however certain useful features of this system which still survive and are being utilized in relay boards in U. S. A. The "common control" has been dropped and a register, permanently part of each link equipment substituted; the trunking is now practically identical with straightforward Strowger, as, too, are the transmission feeding arrangements.

The retention of the register has already been touched upon.

Such a translation device is essential to allow the decimal impulses from the dial to cause the selection and operation of the appropriate "tens" and "units" relays to connect the wanted line.

This divorcement of the functions of dial impulse counting and recording and of connecting (analagous to direct wiper movement in a switch) opens up methods of providing certain facilities in small systems that are more difficult of achievement, *per se*, at the same cost in systems using 100 point step by step switches.

The saving thus achieved can be offset against the increased cost of the relay connecting means and so provide small relay systems at a cost not superior to similar switch operated schemes.

The inherent peculiarity of relay systems resides in the fact that the dialled digits as received by the register can be utilized for a number of different purposes in addition to causing connection to one particular line or one of a group of lines.

Some of these features are indicated in British Patent No. 181,119 (Relay Automatic Telephone Company. F. M. Ward & B. B. Johnson) of July 3, 1921 relating to a relay register which will (a) "perform its functions upon the receipt of less than three series of digit impulses" (b) "absorb more than three series of digit impulses and make use of, for instance, only three of the digits represented by the impulses," and (c) "absorb more than three series of digit impulses and make use of the whole of the digits represented by the impulses.", and in which Claim 2 reads:—"An impulse counting device, a number recording device controlled thereby and means whereby the condition of the recording device can be modified in order to require for its operative setting a variable number of series of digital impulses" and further features are in British Patents Nos. 211,229, 211,230, and 211,231 of 17/11/22 (Relay Automatic Telephone Company & B. B. Johnson) relating to party lines. The latter patent states that:—

"Party lines may be divided in general into two classes, those in which connection is set up to the wanted line over one route irrespective of the station to be called, and those in which the connection is set up over different routes according to the station to be called.

"The former of these two methods has the advantage that the number of lines for which the exchange can provide accommodation is not reduced if some of the lines are party lines, but it has usually required that an auxiliary switch be associated with the ringing group.

"The latter of the two methods, whilst obviating the necessity for the provision of a step-by-step switch, has very considerably reduced the number of lines, as distinct from stations, which can be accommodated on the exchange. If for instance, all the lines on a 1,000 line exchange were four party lines, it has generally meant that only 250 lines could be accommodated."

The object of Patent 211,229 was "to provide a ringing group which shall be capable of supplying any one of a plurality of signalling currents and which shall not require the use therein of a step-by-step switch, whether consisting of relays or other step-by-step mechanism." Claim 1 reads:—"A telephone system in which the grouping of the lines is effected without reference to their designation numbers and in which a ringing group is used in common for calls to direct or to party lines, the signalling apparatus being provided with means not responsive to impulses for connecting thereto anyone of a plurality of signalling currents."

These advantages appertaining to the use of registers in quite small offices, are readily applicable to relay systems, and a relay register can very easily be made to operate immediately upon the receipt of any specified 1st digit, (without waiting for subsequent trains), so that its associated relay connecting group will act as a selector on that digit only, thus enabling a trunk to a distant automatic or manual office to be connected (so that subsequent trains, if any, may be effective in the distant office). It may also act as a two digit register, controlling only part of a level or levels, and allowing the remainder of the same level to be used as a connector; and at the same time it may act as a three or four digit register in which certain trains may be devoted to the operation of connecting relays, and others used for a different purpose, such as indicating the class of service to which a wanted line belongs or designating which station on a multi-party line is required.

If it is desired to maintain the line capacity of an automatic exchange to its full extent, the introduction of a party line system (up to ten parties per line) postulates the use of an additional digit in the calling number to identify the particular party wanted and if more than ten parties are being worked per line, two digits beyond those actually indicating the line number must be used.

Many small offices are called upon to cater for more than one type of party lines of each type or how many individual lines may be required to cope with varying conditions in the district from time. In such cases, a relay register may be conveniently employed to avoid having to divide the lines into rigid groups of any one class and consequently the total fitted capacity of an exchange may be made comparatively smaller.

These advantages do not have the same weight in larger offices. In cases where the number of lines demands the use of selectors, these provide, without any addition or modification, for reaching a distant office on a single pull of the dial.

As regards various classes of party lines, it may very easily become cheaper to provide only certain final switches with ringing of a particular character, rather than make every connector capable of providing whatever description of service may be demanded. In systems in which the majority of the lines are individual, there is no valid reason to incur the cost of party line ringing arrangements in the connectors serving such individual lines, and it is very often more economical as well as giving more popular and better service to allocate the additional di-

gits only to the party lines which actually must have them.

A decision as to the method best suited for any individual case, like so many of the problems associated with automatic telephony, can only be made after careful consideration of the various facilities to be provided, and a study of the position not only of the initial installation but as its development studies indicate it will be at the ends of the usual 4, 10 and 15 year periods.

Somewhat similarly it is not possible, amongst a number of systems of proved practical worth to arbitrarily recommend any one system as being more suitable than another. It is essential that each case be carefully examined and all the factors given due consideration.

The relay idea is not new; during the last twenty years it has been examined by the engineers of telephone operating companies and authorities all over the world, as well as by the manufacturers of automatic telephone apparatus, and there must be a reason for its abandonment in Europe and limited application elsewhere.

There is no doubt that relay systems can be constructed so as to provide all the service facilities that experience with switch systems have shown to be desirable features of automatic telephone service. But apart from the instances previously mentioned, it is difficult to call to mind any facilities unique to relay systems, or which can be provided more efficiently (from a technical or economic aspect) by restricting the apparatus employed solely to relays.

As a matter of fact, every automatic telephone system employs a large number of relays and it is natural to suppose that factories, which are therefore well equipped to turn out this particular component, would if at all possible concentrate on this one product.

From the manufacturing point of view it is not a question of "switches" or "relays", but of "switches" and "relays", and we should expect the automatic telephone manufacturing companies to be strongly in favor of relays only. That such is far from the case can only signify that the engineering staffs controling these factories are strongly convinced that relays alone are inadequate and that some other form of electrical device (incidentally, probably more difficult to manufacture) must be introduced to satisfactorily meet the demands of what is a most important feature of the public service.

In Europe the engineers acting for the various governments reached the same decision and as a result not one factory there is today manufacturing complete relay exchanges for public service. (This statement excludes ten line equipments for pole mounting, apartments houses, etc.)

Of course, the R. A. T. system, as is evident from a cursory glance at Fig. 4, possessed many features that removed it from any category representing a switch system, in which the switches were constructed solely of relays. Relay systems that employ such switches are capable of direct comparison with the particular system they broadly follow, as had been done in the earlier part of these notes. They result in systems, which whilst flexible on paper, are awkward to lay out in practice to accommodate growth.

There are, without doubt, situations in which their use can be eminently satisfactory. These are, ordinarily, small installations, handling traffic of low intensity, but called upon to provide a variety of facilities. If any considerable degree of growth is anticipated, either in lines or traffic, care should be taken to insure that due provision has been made accordingly.

B. B. Johnson,
Formerly Chief Engineer of the
RELAY AUTOMATIC TELEPHONE CO. LTD.
London, England
August 25, 1938.

Estimating Costs

(Continued from page 34)

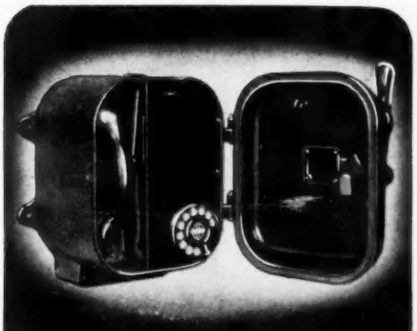
must be so arranged as to present continously all such governing factors which affect the labor required for each pole to the end that the engineer compiling the table of relatives may have advantage of comparative figures for other types and classes of pole as well as the data regarding the pole on which he may be working at the moment. A typical tabulation for working out labor relatives is shown below.

Labor Relative Computation
Western Red Cedar Poles

Pole Data—						
Length Feet			30			
Class	1	2	3	4	5	6
Circumference 2′ from ground	40.0	38.5	34.6	32.5	29.9	28.0
Diameter Hole in inches	20.0	19.0	19.0	18.0	17.0	17.0
Depth Hole in feet	5.5	5.5	5.5	5.5	5.5	5.5
Trenching	....	...	not required ...		....	....
Cubic yds. Excavation	.425	.401	.401	.360	.321	.321
Approx. Wt. in pounds	1000.0	850.0	730.0	610.0	500.0	420.0
Man Hours—						
Digging (Light)	4.100	3.780	3.780	3.553	2.443	2.443
Erecting	.826	.800	.800	.800	.655	.550
Tamping	.500	.485	.470	.470	.470	.470
Lining	.200	.200	.187	.175	.150	.150
Moving	.125	.125	.125	.120	.120	.100
Locating	.500	.500	.500	.500	.500	.500
Hauling	1.880	1.860	1.350	1.350	1.060	1.050
Unloading	.795	.645	.615	.485	.395	.390
Total Man Hours	8.926	8.395	7.827	7.453	5.793	5.653

In this illustration it will be noted that the labor relatives for unloading and hauling have been included. This was possible because in this case the practice of the company as to the storage and distribution of poles had been reduced to a standard throughout the territory. As has already been shown the freight on poles should properly be added, as a loading, to the material cost. It should also be mentioned that the digging relative shown is for Light Digging. For other conditions of soil it is possible to develop a relative factor table, applicable to the basic relatives for Light Digging, similar to the table shown above for City and Rural Toll Pole setting Direct Labor Costs.

The thoughtful reader will at once note that the labor relatives shown in the illustrative tabulation above are definitely limited to the actual work directly required for each of the several component operations incidental to placing poles. While this is an essential condition for maximum accuracy, especially when the desirability of developing unit costs for retirements is fully recognized, it discloses the necessity of providing for certain other costs for labor which are not directly associated with any units of plant but must be incurred by the company in any construction program. It is the opinion of the author that such labor costs are preferably handled as a weighting on the hourly wage rates but this is a controversial subject. The important thing to keep in mind is that such direct labor costs, which are actual but not directly assignable to any units of plant, must be included somewhere in order to avoid *understating* the cost of the project. To illustrate the type of labor costs meant consider the following imaginary set of circumstances. The telephone company has up for executive consideration a completed estimate for the construction of certain pole lines. The plant accountants show that the company actually paid for 1,000 hours of labor charged to this estimate but that the total number of man hours assignable to the units of plant actually completed is 800 instead of 1,000. Investigation of the original work and time reports will undoubtedly disclose that the discrepancy of 200 man hours is chargeable to overtime, rainy weather, sick time, breakdowns of equipment and other similar causes. It should be obvious that such a disclosure indicates that future estimates must be gauged to cover this sort of thing in order to avoid serious error. Now this can be done in either one of two ways. Either the weighted hourly rate of pay can be weighted 20% (assuming that the condition described above is the actual experience of the construction department) or the labor relative can be weighted and the weighted hourly rate of pay be



FOR HARD *Service* IN EXPOSED LOCATIONS

Taxi stands, lumber yards, and factory grounds are typical places served by Outdoor Monophones. These weatherproof instruments enable you to provide needed service to—and **obtain new revenue from**—many locations not now supplied with telephone facilities.

Automatic Electric Outdoor Monophones have cases of cast-aluminum alloy. The door, lock-equipped, seals tightly against a rubber gasket. All wiring is rubber covered, and ringer and induction coil windings are impregnated with waterproofing compound.

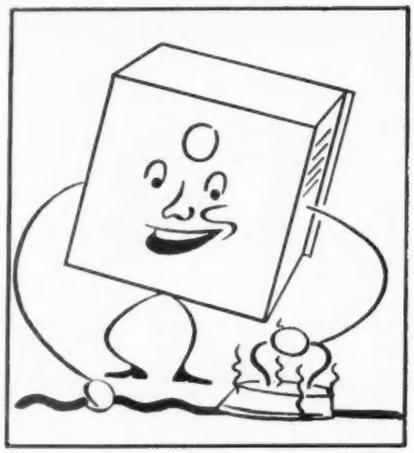
Available for manual or automatic common battery service, and for magneto operation. Write for complete details and prices.

AUTOMATIC ELECTRIC

AE

TELEPHONE, SIGNALING, AND COMMUNICATION APPARATUS

Distributors in U. S. and Possessions:
AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
1033 West Van Buren Street, Chicago, U.S.A.



High efficiency in converting AC to DC makes Raytheon RectiFilteRs most economical for PAX and PBX operation. Voltage output is stabilized. Trouble and expense of frequent inspections are eliminated. Plug in a RectiFilteR and forget it.

Raytheon RectiFilteR

Each RectiFilteR installation saves from $30 to $90 per year. Full range of sizes. Equipped when necessary to furnish DC power during AC interruption. Send for bulletin DL-48-156F.

RAYTHEON MANUFACTURING CO.
134 WILLOW STREET, WALTHAM, MASS.

Pole Labor Placing Wage Rate Costs per Man Hour		
For complete project		
Total Digging Man Hours	31,000	71.6% of total Man Hours
Total Erecting, Lining, Tamping and Moving Man Hours	12,300	28.4% of total Man Hours
Total Man Hours	43,300	100.0% of total Man Hours

left as computed from the payrolls. If the labor relatives are left undisturbed they can be used again and again in estimating construction costs under the same conditions and that seems to the author to be preferable, for that reason, to the method in which they are distorted because of a condition which not only varies for different organizations but which also varies according to seasons and other causes which cannot be controlled in the same organization. In other words the cost of lost time is an unquestioned part of the cost of any project but it is not a constant factor in the labor assignable to individual units of plant and actually does vary from group to group and from season to season.

Hourly Rates of Pay

IN order to preserve the identity of unit costs it is advisable, as has been shown, to determine the total man hours associated with each. To such individual unit costs in man hours it is, of course, necessary to apply the proper rates of pay in order to determine the direct labor costs as a basis for the subsequent application of the loadings which depend upon the direct labor. This makes necessary the computation of the rate per hour which is being currently paid for time directly associated with units of plant in the organization for which the cost of any project is being estimated. This can be done by setting up a typical gang, and this is fairly accurate, or by determining the actual weighted average rate for the entire force assigned to the type of construction involved in the estimate.

The determination of the hourly wage rate *cost* for an imaginary pole line project is made, by one method, as shown above.

This shows that out of every 1,000 Man Hours required for the project in question there were 716 Man Hours required for digging and 284 Man Hours required for the other operations of setting the poles. The determination of the weighted average wage rate cost per Man Hour is then as shown below.

It is believed that this illustration will be found entirely clear but it is given as an illustration of a *method* only and the figures are not set out as being correct for any given situation. The slightest consideration will show that such determinations as that illustrated must be made to suit the conditions in the organization and under the construction conditions to which they are to be applied.

ACT NOW!

Effective October 1, 1940, the subscription price of TELEPHONE ENGINEER for 1 year increases from $1.00 to $1.50. Act now to save the difference.

Average (weighted) rate for second class linemen		$0.4710 per hour
Average (weighted) rate for first class linemen		0.6013 per hour
Average (weighted) rate for gang foremen		0.9053 per hour
716 Man Hours at $0.4710 per hour	$337.24	
284 Man Hours at 0.6013 per hour	170.77	
1,000 Man hours	$508.01 actual payroll cost	
200 Man Hours (lost time, 20%)		
800 Man Hours Used in Actual Construction	$508.01 actual payroll cost	
Weighted average wage rate cost per hour	.6350	
Hourly wage rate cost per hour for gang of six men (excluding foreman)	3.810	
Average (weighted) rate for foreman	.905	
Hourly wage rate cost per hour for gang including foreman (seven men)	4.715	
Composite average wage rate cost per man hour for setting poles	0.674	

25 YEARS AGO THIS MONTH

Taken from TELEPHONE ENGINEER files of SEPTEMBER, 1915

Dr. J. H. Close quits Kansas Public Utility Commission to become secretary of the Kansas Independent Telephone Association, succeeding Fred Coulson, who reenters telephone work at Abilene.

▲

August 19, 1915, saw eight feet of water standing in the main exchange of the telephone office at Galveston, Texas. A Ford automobile furnished power to operate the exchange while repairs were being made.

▲

The Kansas State Normal at Emporia, Kansas, performed a neat feat in community service when a musical program was transmitted over telephone wire. This is said to be one of the first of its kind.

▲

Frederick W. Kessler, for eight years manager of the Valley Home Telephone company, at Bay City, Mich., has been promoted to general commercial agent.

▲

Samuel P. Fisher is appointed receiver of the Capital City Telephone company at Washington, D. C., operating the system in that city and surrounding territory.

▲

Central Telephone & Telegraph company at Paxton, Illinois, elects G. J. Johnson, president, and H. B. Henderson, secretary-treasurer.

▲

The Western Electric company at Estherville, Iowa, begins work on a $65,000 exchange for that town.

▲

City council of Wayachie, Texas, rejects proposal of the telephone companies of that town to merge the Bell company with the local independent company.

▲

Hurricane strikes Houston, Texas, causing damages to the Southwestern Bell exchange of $100,000.

▲

A. B. Campbell has sold the Marcus Telephone exchange, Marcus, Washington, to H. P. Thayer of Denver, Colorado.

▲

Grafton, West Virginia, is demanding consolidation of the two telephone exchanges in that city, according to information from that place.

Ramsay Retires; Ramsay Succeeds

W. Y. Ramsay, engaged in the telephone business for almost forty years and for the past thirty years General Manager of the Peoples Telephone & Telegraph Company properties in Menard county, retired from active service as of June 30, and his son, William Ramsay, Jr. was promoted to the position thus left vacant, on July 1.

The elder Mr. Ramsay is a veteran in the service of the Bell Company, having first entered the service more than thirty-eight years ago, at Bloomington. Later he served as manager of properties at Oquakwa, Stronghurst and Chenoa. There were two companies operating in Petersburg and a few years later, when they consolidated, he became general manager of the business, and has held the position since that time.

Although several years past the usual retirement age, Mr. Ramsay remained active in the affairs of the company, and his resignation came at his own suggestion, because of impaired health during the past year.

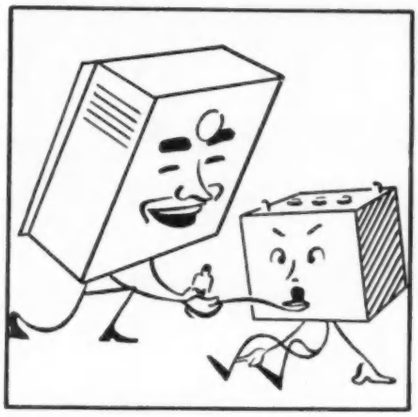
William Ramsay, Jr. earned his promotion through years of service to the phone company, having served more than thirty years in various capacities, starting with the line crew and working up through various positions to that of Plant Superintendent, a position which he had held for several years. The new General Manager is active in civic affairs, being a member of the three Masonic bodies, the Rotary Club and the American Legion.

Installs Two North Relay Boards

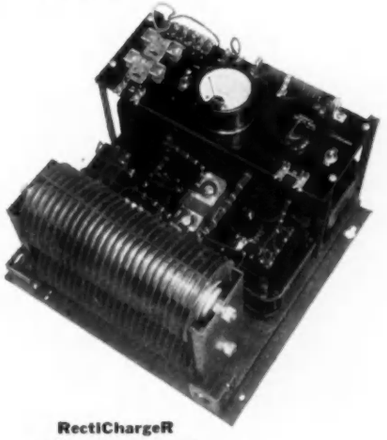
Mr. Ralph Sparks, Manager of the Pecos and Northwestern Telephone Company, Pecos, Texas, announces that their company has just completed the installation of two North Electric all relay switchboards in Balmorhea and Barstow, Texas. Both are housed in new fire proof buildings, both one hundred line switchboards with fifty lines equipment. Barstow is seven miles from Pecos and Balmorhea forty miles distance. The Pecos Exchange serves as control office for the unattended automatics.

Increasing Demands

The Columbia (Penn.) Telephone Company has added four men to its plant personnel, and a new line truck to its fleet of motorized equipment. These additions were necessary, it was announced, to take care of increasing demands for service and new plant improvements and extensions either under way, or planned.



Correct feeding for batteries, assured by Raytheon RectiChargeRs, prevents overvoltage troubles such as noise, short lamp and battery life, incorrect ringing, sticking relays. Put your batteries on the right diet with a RectiChargeR, and save money.

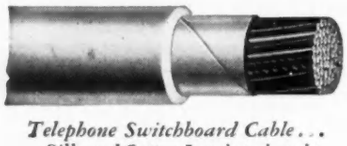


RectiChargeR with cover removed

A RectiChargeR with a small storage battery floating across its terminals makes a complete, automatic, AC-DC, constant-voltage telephone power unit. Components are long-lived, maintenance-free. Consult your usual source of telephone supplies for the correct RectiChargeR for your needs. Write for bulletin DL-48-263ATE.

RAYTHEON MANUFACTURING CO.
134 WILLOW STREET, WALTHAM, MASS.

ROEBLING
electrical
Wire & Cable

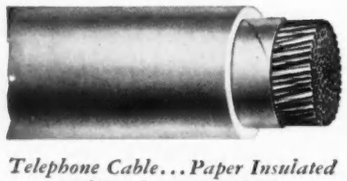


Telephone Switchboard Cable... Silk and Cotton Insulated and Leaded... 50 Pairs.

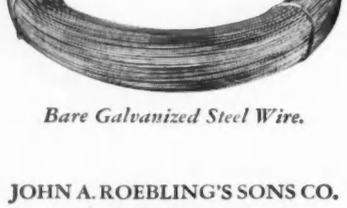
Twisted Pair Telephone Wire... Rubber Insulated and Braided.

Bare Copper or Bronze Wire.

Galvanized Steel Strand.



Telephone Cable... Paper Insulated and Leaded... 150 Pairs.



Bare Galvanized Steel Wire.

JOHN A. ROEBLING'S SONS CO.
TRENTON, N.J.
Branches in other cities

ONLY A FINE PRODUCT MAY BEAR THE NAME ROEBLING

Short Course in Telephone Transmission

(Continued from page 22)

Note—(1) R_a, R_b, and R_c represent the attenuation of the individual circuits, while R_1, R_2, and R_3, represent the measurements obtained on the several combinations of circuits on a loop back basis.

(2) The above equations are also useful in measuring the ohmic resistance of individual wires on a loop back basis.

W. E. No. 1-C Attenuation Measuring Set

ONE of the best known transmission measuring sets of the Ear Balance type is the W. E. No. 1-C, shown in Fig. 4. This instrument has a range of 0 to 46 decibels in steps of 0.5 db. The instrument is designed to match a 600, 1200, or 1800 ohm circuit under test. The switching key which throws the listeners receiver from the circuit under test to the adjustable network is arranged to cut in a resistance across the circuit from which the receiver is switched in order to maintain a uniform load impedance condition across the oscillator terminals.

Attenuation Measurements with Meters

In recent years the development of the copper oxide type A. C. voltmeter has resulted in a simplified and improved method of making attenuation measurements. The new method offers the distinct advantage of **straight-of-way** testing, thus eliminating the "loop back" method usually required with the ear balance testing.

The newer method requires a 1000 cycle oscillator and two copper oxide A. C. voltmeters. One voltmeter is used to measure the power input (in terms of voltage to the line, while the other is used to measure the power arriving at the distant end of the line (power output). The two meters are generally calibrated in decibels and often referred to as **power level indicators.**

The actual attenuation of a line or apparatus is equal to the algebraic difference in the readings of input and output meters. For example, if the input meter reads **plus 3.0 db** and the meter at the distant end of the line **minus 10 db,** then the attenuation of the line would be plus 3 minus 10 or 13 db. This method of measuring attenuation is shown in Fig. 5.

Basis of Power Level Method

THE basis for this method of measuring circuit or apparatus loss is the basic decibel equation, viz:

$$db = 10 \log \frac{P \text{ in}}{P \text{ out}}$$

As this equation states, the loss or gain in decibels in any circuit is equal to ten times the logarithm of the output power to the input power.

The power input and output in a telephone circuit can be measured most readily by means of either an A. C. voltmeter or an A. C. milliammeter as suitable instruments for measuring power directly (a wattmeter) at telephone frequencies are not available. The power impressed across the input end of a line under measurement or received at the output end is determined by voltage or current measurements by the following equation:

$$\text{For voltage measurement } P = \frac{E^2}{Z}$$

$$\text{For current measurement } P = I^2 Z$$

Thus if we know the line and load impedance and measure either the voltage across, or current through this impedance, we can readily determine the input and output power. With the input and output known, the corresponding loss or gain is readily computed either by means of the basic decibel equations or by merely referring to a table of decibels vs. voltage or current ratios.

For example if we find the ratio of output to input voltage to be 0.2, we can by reference to a table of db vs. voltage ratios readily determine that our loss is 14 db. Fig. 6 shows several typical power level indicators useful in telephone plant measurements.

Impedance Must Be Taken Into Account

IT is important to remember that in using a voltmeter as a means of measuring the power input or output on a telephone line that the impedance of the circuit across which the voltmeter is connected must be taken into account, otherwise the readings will be in error. For example, assume that we measure the voltage across the input to a step up repeating coil having an impedance ratio of 1 to 4 (voltage ratio 1-2), and an input impedance (the oscillator) of 500 ohms. We also measure the voltage across the output of the coil which feeds into a 2000 ohm load. Now, even though our repeating coil has some loss, our output voltage will be higher than the input voltage because of the voltage step up effect of the trans-

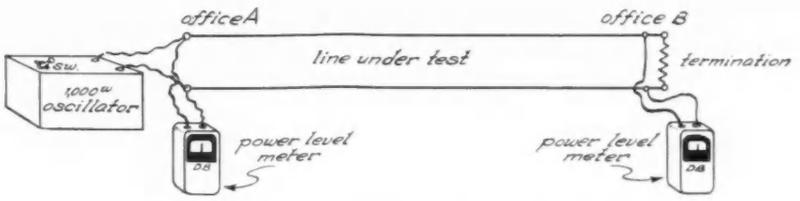


Fig. 5—Use of power level meters for attenuation measurements.

former.

For example, if we measure 10 volts across the input to the coil and 20 volts across the output or load impedance and if we ignored the inequality of input and output impedances, we would from the db vs. voltage ratios find that our repeating coil in effect had a gain of approximately 6.0 decibels and yet we know this to be impossible, as the coil should, if anything, show a loss rather than a gain. If we substitute our readings in the power equations, however, and by this means determine the true input and output power, we can refer the power ratio obtained to a table of dbs vs. power ratios and expect to get an accurate answer, that is:

$$\text{Input power} = P = \frac{10^2}{500} = 0.2 \text{ watts}$$

$$\text{Output power} = P = \frac{20^2}{2000} = 0.2 \text{ watts}$$

$$\text{Power ratio} \left(\frac{\text{output power} = 0.2}{\text{Input power} = 0.2}\right) = 1.000$$

From table—power ratio of 1.0 equal zero loss.

Note—Actually there would be a slight loss in a practical repeating coil (about 0.5 to 1.0 db).

From what has been said, it will be apparent that as long as our input and output impedances are approximately equal that we can use voltage ratios safely and without correction. This is true whether we are using a regular A. C. voltmeter calibrated in volts or a power level type of meter calibrated in db. Keep in mind that a power level meter is nothing but a copper oxide voltmeter calibrated in decibels instead of volts, and that the scale readings will only hold true when the meter is used on the impedance for which it is calibrated.

Most power level meters now in use in the telephone field are calibrated for 600 ohm lines, although some of the older ones were calibrated for 500 ohm lines. Zero db or level is considered as 0.005 watts in some meters, and 0.001 watts in others.

(TO BE CONTINUED)

Rehabilitation

The United Telephone Company has announced plans for completely rehabilitating the exchange plant at Hanover, Penn. New automatic, or dial operated, central office equipment will be installed in a newly renovated and modernized building. Underground cable will replace aerial cable in the downtown section. New cable and poles will replace other outside plant, some of which will be re-routed and extended. When completed in early 1941, the new plant will serve some 3,000 of the United Company's 27,000 stations.

B. A. Fergason Is Watermelon Champ

In reports of outings, picnics, etc. the name of B. A. Fergason, Southwest Telephone Company repairman, at Alvord, Texas, is continually being reported at watermelon feasts or watermelon festivals. The Grapevine district of his company recently held a watermelon feast at Eagle Mountain lake, near Ft. Worth, and we find his name, together with his family, leading the list. Then again we find him as general chairman of the Watermelon Festival at Alvord, which begins to become suspicious. We are undecided whether he loves them or raises them.

South Carolina Selects Convention Headquarters

Word has just been received that the South Carolina Independent Telephone Association has selected the Wade Hampton Hotel in Columbia, as convention headquarters. The meeting is scheduled for November 11 and 12.

District Meetings Scheduled in Kansas

According to H. B. Couch, secretary of the Kansas Telephone Association, two district meetings will be held this month. The first is scheduled for September 19 at Wilson and the second at Burlington on September 27. Interesting subjects will be discussed with sessions to open at 12 noon for luncheon and end at 4 p. m.

IF YOU WANT TO BE A

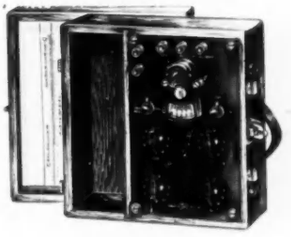
Fault-finder

BE A GOOD ONE!

USE THE NEW

SHALLCROSS

FAULT LOCATION BRIDGE



Here's an inexpensive, well-constructed instrument that reduces the maintenance cost of communication lines (telephone, telegraph or signal) by *simplifying* the job of locating trouble.

Presents a new idea in cablemens' fault location equipment.

The "Fault Location Chart" supplied with each instrument reduces calculating and distance determination to an absolute minimum. Makes ridiculously easy the frequently necessary job of finding grounds, crosses, shorts, etc. Designed by a telephone engineer. Requires no special skill on the part of the user.

Write today for Bulletin No. 627-NP.

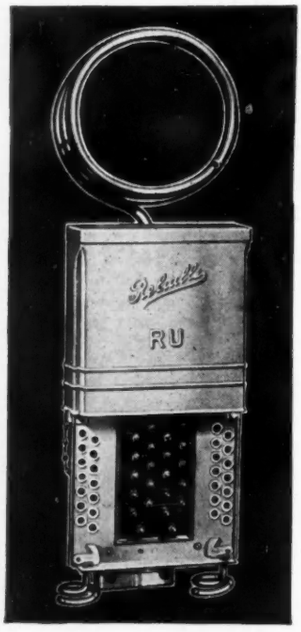
SHALLCROSS MFG. CO.

Instruments – Resistors – Switches

COLLINGDALE, PA.

A DEPENDABLE

CABLE TERMINAL



Reliable

Type RU unprotected terminals are easy to install, easy to work on and built to outlast the cable.

Upon request we will send a sample for your inspection without charge.

Reliable ELECTRIC COMPANY
OVER 25 YEARS SERVICE TO THE UTILITIES

The Longitudinal Circuit

(Continued from page 20)

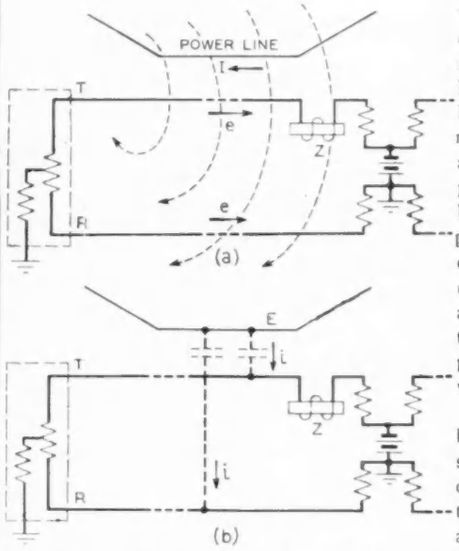


Fig. 5—Disturbances from the outside may be induced by either inductive or capacitive coupling, and the methods used for their control will vary accordingly.

duced. Although the choke coil used under these conditions will not greatly reduce the disturbing current, it may divert it from the unbalanced termination at the right (see Figure 5) to the balanced termination at the left.

Another method of reducing the longitudinal current in unbalanced circuit elements is by the use of drainage coils. As indicated in Figure 4b, this consists of a coil (generally with series condensers to block direct current) shunted across the line, and grounded at its midpoint. The two halves of this coil are wound series aiding so that to metallic-circuit current, tending to flow through it from one side to the other, it offers a high impedance. To longitudinal current, however, flowing from both lines to the midpoint, the impedance is very low. Such a coil thus forms a very low impedance path to the disturbing currents, and can be used to drain off by far the greater part of them before they reach unbalanced circuit elements. Neither drainage nor choke coils, however, can be inserted in a telephone line without careful study of their effects on transmission and on all possible circuit operations that are involved.

Another common means employed to break up the longitudinal circuit is to sectionalize the line, so that the longitudinal current is limited to certain sections only. In a phantom group, for example, the office termination, as indicated in Figure 6a, provides no longitudinal path through the office except through the coil capacitances, and since these are small, the longitudinal path is of high impedance except at high frequencies. A form of sectionalization occurs in Figure 2a, since the longitudinal current cannot pass the battery feed, and thus cannot react with any other unbalances to the right of this point, unless the central-office ground is poor.

In many arrangements proper grounding is very important. In Figure 6b, for example, which represents a regulating 44-A-1 repeater circuit, the effect of the unbalanced gain control is partially eliminated by the sectionalization provided by the repeating coil. The arrangement of the grounds X and Y, however, is very important. If there is a difference in

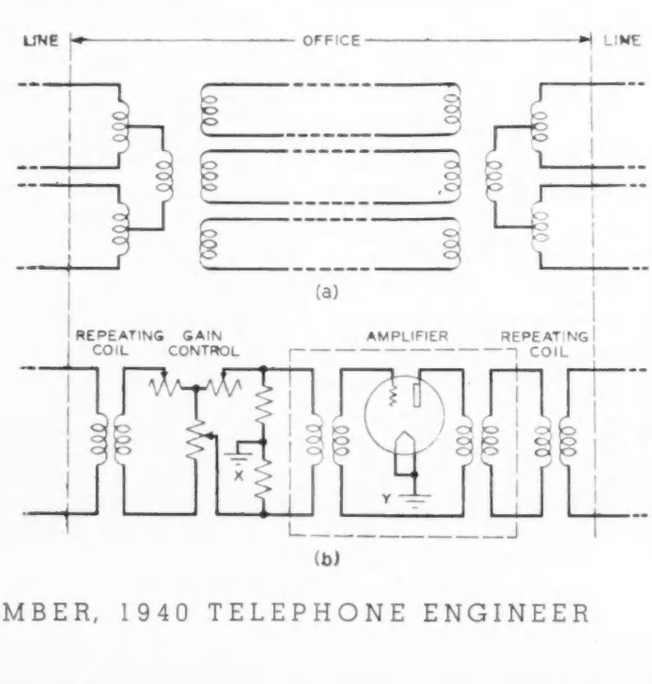


Fig. 6—Sectionalization, as in the phantom termination at (a), is an important method of limiting the effect of longitudinal current. With sectionalized unbalanced circuits, as at (b), the grounding becomes of great importance.

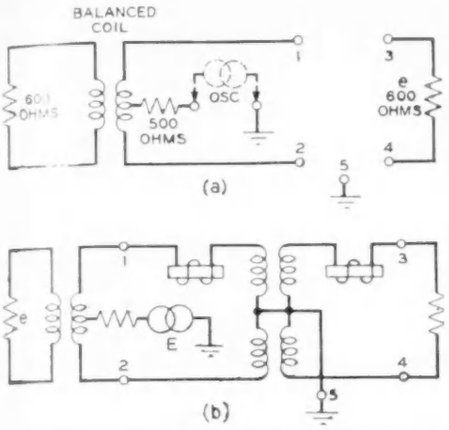


Fig. 7—Circuit for unbalance rating, at (a), is shown with a circuit connected for measurement at (b).

potential between them, it will appear in part on the grid-filament circuit of the first tube through the capacitance coupling between the windings of the input transformer.

Another method for reducing the longitudinal current is neutralization. This method has, to date, been used largely for low-frequency rather than for high-frequency induction.

Before remedial methods can be satisfactorily applied, it is frequently necessary to measure the unbalance of circuits and circuit components. In fact it is part of normal telephone circuit development to insure that the designs are adequate with respect to unbalance. To facilitate such measurements, an unbalance rating circuit has been developed. Its essential features are shown in Figure 7a. An oscillator serves as a source of longitudinal current and is fed into the test circuit at the midpoint of a repeating coil. The apparatus or circuit to be measured is connected to the terminals 1, 2, 3, 4, and 5, as shown in Figure 7b. The ratio of the metallic-circuit voltage e to the applied longitudinal voltage E gives a measure of the circuit unbalance. One form of this circuit is shown being used in the photograph at the head of this article.

(END)

Station Gains Spurt Upward

American Telephone and Telegraph company has announced that the number of telephones of its chief subsidiaries in use gained 65,400 inAugust. The gain for last July was 22,400 and for August, 1939, 52,300. The net gain for eight months this year was 536,700, against 433,400 for the corresponding period in 1939. At the end of August there were about 17,071,000 active telephones in the Bell system.

Strike in Indiana Exchange Settled

Garrett, Ind., Aug. 15—Garrett housewives were assured today that they will get excellent phone service next time they want to call the butcher or the baker.

Eight operators and one clerk who struck for seven hours last Friday and left the city without any service except a line to the city hall on Wednesday night signed a year's contract with the company.

Johnstown Gets New Central Office

The Pennsylvania Telephone Corporation has announced plans for the installation of a new central office in the Johnstown exchange area. Located at the junction of Christopher and Goucher Streets, the new central office will be housed in an attractive, new fireproof structure; in which glass building blocks will be used to permit sunlight and to exclude dust and moisture. Consisting of automatic apparatus, the new office will cost approximately $100,000 and will provide facilities for switching some 2,000 subscribers located in the immediate vicinity.

If Someone said — "Here is Some Gold — all yours for the asking" — with little or no effort to obtain it, would you seek further information?

•

Loud Speaking Telephone offers you such an opportunity.

•

See our equipment demonstrated at the National Convention next month. Prepare to order a sample.

Write for particulars.

BANK'S MANUFACTURING COMPANY

5019 N. Winthrop Avenue
CHICAGO, ILL., U.S.A.

The 85-Year-Old Secret...
THAT CUTS TELEPHONE OPERATING TAXES TODAY

WELCOME indeed is *any* tax-relief from your operating budget. Thrice welcome this relief when you're assured, through Hemingrays, that the tax-saving is permanent . . . "has lasted 50 years"— one prominent utility reports.

REASON lies in the 85-year-old secret Hemingray glass "batch-mix"— plus Owens-Illinois quality-controlled production. Result! Insulators free of voids, strains and stresses and so homogeneous that moisture can't penetrate them. Temperature changes leave them unimpaired—they outlive poles, hardware and crossarms.

COST IS LOW, supply constant, but only through principal jobbers.

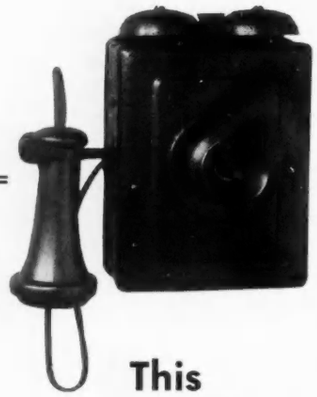
The Rural "Toll" Line Favorite

. . . is Hemingray Number 42. Its long leakage path means trouble-free operation. Other rural headliners . . . Numbers 9 and 16. Ask for samples.

OWENS-ILLINOIS

HEMINGRAY Telephone & Telegraph Insulators · LOWEX Power Insulators

Export Agents: International Standard Electric Corp., New York



This Common Battery Metal Wall Set Only $7.10

Nothing more to pay—no old telephones to send in. $7.10 brings you this common battery Autelco Rebuilt manual wall set. Has straight-line ringer, metal case, and exposed gongs. Same features with wood case, $6.95.

Save more by sending in old telephones for rebuilding. You benefit from one of Automatic Electric's most popular services for independent companies. For complete details of AR service—and for special low prices—send coupon today.

AUTOMATIC ELECTRIC

AE GD

TELEPHONE, SIGNALING, AND COMMUNICATION APPARATUS

Distributors in U. S. and Possessions:
AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
1033 West Van Buren Street, Chicago, U.S.A.

The MARK of QUALITY in Rebuilding Service for Independent Companies

AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
1033 W. Van Buren St., Chicago, Illinois

Please send me a copy of Circular 1640-B.

Name .....

Company .....

Address .....

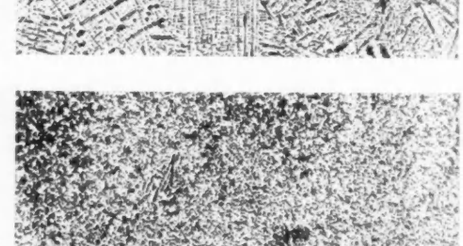
A Wiping Solder With Improved Handling Characteristics

By EARL E. SCHUMACHER
Associate Research Metallurgist
Bell Telephone Laboratories

THE large lead sleeves that go over splices in telephone cable are joined to the sheath by "wiping" solder, so named in description of the manner in which it is applied. The splicer first pours molten solder over the areas to be covered, to heat them to a temperature at which the solder will wet them. He then catches some of the semi-molten mass of solder in a cloth and wipes or molds it into place. To anyone watching, it seems a simple enough operation; however, it requires considerable skill on the part of the splicer and an exacting balance among the properties of the solder. For instance, the satisfactory solder should melt and would be melted in those parts. This property is secured by alloying lead with tin. Such an alloy has the two further properties of readily wetting lead when hot, and of being about as strong when cool. As a lead-tin alloy cools, part of it solidifies while the rest is liquid, and it is during that "mushy" period that the splicer forms the mass with his wiping cloths. The period should be reasonably long and during it the tendency for the joint to drain liquid metal or break apart should be a minimum. Finally there should be no undue oxidation at the higher temperatures sometimes encountered in practice.

With this knowledge of the requirements, it would appear at first sight that the quest for a better solder would be simple; merely produce an alloy which retains or improves upon the present desirable properties of lead-tin while eliminating those that are objectionable. The fact is that this task proved to be extremely difficult, and comprehensive experimentation was necessary. An interesting story could be told about the different alloys that were made during this study: how one added element affected one property and another another. It is sufficient to say that an alloy was finally developed whose properties closely approximate those sought.

The new solder has a nominal composition of 37.25 per cent tin, 0-10 per cent arsenic and the balance lead. This addition of arsenic would seem to be a small quantity to effect such a modification in properties, were it not that researches of recent years have shown how much the properties of metals and alloys can be changed by additions of small quantities of other metals. Metallurgical theory indicates that the added arsenic combines with tin to form a high melting compound, probably Sn_3As_2. This compound is the first material to freeze out from the melt and provides a very large number of small nuclei around which the lead-rich solid solution deposits, forming a correspondingly large number of crystallites. Without this seeding action of the arsenic compound, standard solder commences to crystallize at relatively fewer locations and thus a given amount of solidified material is distributed as coarser crystallites, fewer in number



Above, a 38-62 per cent wiping solder, cooled slowly, sectioned and etched. Below, the same alloy with 0.1 per cent arsenic added.

Since the finer crystallites in the new solder have a relatively greater ratio of surface area to volume and, being much smaller, pack more closely, there is appreciably less tendency for drainage of liquid metal. This source of leaky joints is therefore minimized.

Since less total solid phase is required in the new alloy to retain the liquid solder, molding of the joint can be commenced sooner and since finer grains are formed the mass does not become solid as soon, thus permitting manipulation to continue longer. Some

splicers who have used the new solder refer to it as having a "buttery" or "velvety" feel during its manipulation, another way of saying that it is extremely moldable. An analogue may make this behavior clearer. Ordinary solders when partially solidified may be compared to a coarse sand and water mixture, the lead-rich crystallites, which separate out on freezing, corresponding to the sand particles, and the liquid metal to the water. The arsenic-bearing solder on the other hand may be compared to modeling clay whose solid phase is in a very fine state of subdivision. Modeling clay as is well known is much superior to a sand-water mixture in moldability. With the arsenic-bearing solder the forming period is increased and in addition the formability is improved. Both of these features are a direct consequence of the finer texture.

The tendency of ordinary solders to easy oxidation has already been mentioned. The tendency of the new solder to oxidize even at temperatures appreciably higher than ordinary working temperature is small. This facilitates the wiping operation.

To determine whether any health hazard was involved in using the new solder, an investigation was made to determine whether arsenic or arsenic compounds volatilize from this alloy under the conditions encountered in practice. The result was negative, showing that no hazard is introduced by substituting the arsenic-bearing solder for standard solder.

END

New Handbook Available

The National Bureau of Standards, Department of Commerce, has just made available a handbook containing Part 1 of the revised (fifth) edition of the National Electrical Safety Code.

Dealing with safety rules for the installation and maintenance of electric supply stations, the handbook sets forth detailed information regarding the general protective arrangement of equipment, including oil-filled apparatus, rotating machinery and storage batteries. Specific information is also given regarding such protective devices as fuses, circuit breakers, switches, controllers, and lightning arresters. Separate sections are devoted to conductors and switchboards.

While the current revision shows numerous changes in the detailed wording of the rules, very few changes in substance have been made, since most of the changes are in the nature of clarification and improvement of the statements.

The rules on storage batteries, have, however, been completely revised and the rules on transformers have been revised to recognize the use of a non-combustible cooling liquid, which is one of the new developments of the art.

The handbook also contains the revised rules for the protective grounding of circuits and equipment, which is designated as Section 9 of the Code. Here again the changes are mostly of a minor character, although the conditions for the interconnection of primary arresters with the secondary neutral have been liberalized.

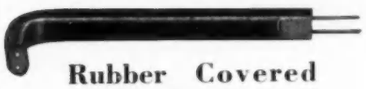
Known as H31, the handbook may be obtained at 10 cents per copy from the Superintendent of Documents, Government Printing Office, Washington, D. C.

$7,635,000 Expansion Program Announced

The federal communications commission on September 10, approved an application by the American Telephone and Telegraph company and the Northwestern Bell Telephone company for authority to install twin all-weather cables between Omaha and Denver.

The cost was estimated at $7,635,000, of which $4,825,000 would be for outside plant equipment and $2,783,000 for carrier and associated equipment. The commission said the project was "another link to relieve transcontinental telephone congestion."

TWINPLY PROTECTED



Rubber Covered Under the Ground Telephone Wire

Many problems—relating to both construction and maintenance—are solved by putting the wires under the ground when you know the insulation will take it.

"Twinply Protected," the new underground wire developed for Suttle, has what it takes. That is, *TWO* kinds of rubber—one for abrasion protection, and one for chemical protection.

The inside gray-colored rubber is a soft composition that is highly resistant to any acids or alkalis that may be present in the soil. They won't get through this protection to the wire.

The outside black coating is tough like tire rubber and permits rough handling of the wire and protects the wire from soil pressure and other forms of abrasion. It isn't so good against chemical conditions.

Makes Buried Lines a Really Safe Practice

See Suttle Catalog or write for sample and prices.

SUTTLE EQUIPMENT CO.
LAWRENCEVILLE, ILLINOIS

Reduce Costs OF TEMPORARY INSTALLATIONS WITH

KEARNEY NO-RENCH SCREW ANCHORS

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO. — The Mark of Quality Products

Provides inexpensive guying of bracket or single phase ridge pin lines.

TIME and again temporary guying is demanded. Immediately, the operating man must think in terms of cost and time. Kearney No-Rench screw anchors, made of Certified Specification Malleable Iron, are 100% salvageable, because the rod and helix are one unit and may be screwed in or out of the ground conveniently.

They are efficient for permanent guying, too, having holding powers from 2,000 lbs. to 13,000 lbs., depending on the anchor size. Ideal for permanent anchorage where lawns or flowerbeds prohibit hole-digging.

TELEPHONE ACCESSORIES *for* BETTER LINE CONSTRUCTION *and* MAINTENANCE

Get Rid of Noise!
with the Improved
VINCENT RARE GAS RELAY

Installed in a Minute
No Moving Parts
Thousands in Service
Fully Guaranteed

Eliminates unbalance noises in metallic party lines employing divided ringing to ground. Works with either harmonic or code ringing.

Write for Catalog 39-A describing
Non-Grounding Rare Gas Arresters
Terminal Strips _ Potheads Housings

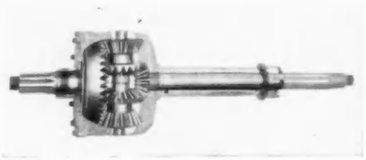
L. S. BRACH Mfg. Corp.
55-63 Dickerson St. Newark, N. J.
Signal Circuit Engineers Since 1906

New Power Proportioning Differential

A new power proportioning differential especially designed for six-wheel drive trucks has been announced by H. B. Dodge, Chief Engineer of The Four Wheel Drive Auto Company of Clintonville, Wisconsin, FWD truck manufacturers.

The new power proportioning differential is used in the power line of six-wheel-drive trucks and distributes the driving power to each axle in direct proportion to their normal loaded weight. The new differential provides full differential action between the driving axles of the truck.

In a six-wheel-drive truck with dual tires on the bogie axles the gross weight is normally arranged so that each of the ten tires on the truck carries its proportionate share of the load. Thus ¼ or 20% of the gross load



Phantom view of new power proportioning center differential for FWD six-wheel-drive trucks.

is carried on the two tires of the front axle while 4/5 or 80% of the gross load is carried on the eight tires of the rear bogie. The new FWD differential provides for a power division so that exactly 20% of the driving torque is delivered to the front axle and 80% of the driving torque is delivered to the rear bogie.

TELERING

Only ONE Contact!
Price $44.00
F. O. B. factory

For better and cheaper ringing
No Radio Interference
30-day free trial
TELKOR, Inc.
ELYRIA, OHIO

Twins Keep Phone Service Uniform

Day and night uniformity is the boast of the telephone company at Mt. Gilead, Ohio, where Mona and Nona Thomas, Morrow County's widely known twins, are rounding out 22 years of service as switchboard operators.

Their voices are so identical that subscribers can't tell the difference, unless they know that Mona works at night and Nona in the daytime.

They look so much alike that even their associates find it difficult to tell them apart.

....from ALL ANGLES A GOOD BUY

THE COMPANY THE LINEMAN PURCHASING AGENT

PROFESSIONAL LINEMAN PATTERN
Lineman's Favorite
58-R—8½" —$3.25
56-R—6" —$2.00
57-R—7" —$2.50
Lineman's or company name etched FREE on handle of each pair.

EVERY time a Purchasing Agent writes "Vacuum Grip Pliers" into his requisition sheet he makes a three-way "good buy"—

He puts into the hands of the lineman and electrician pliers that add to their efficiency and speed—

He gives his company pliers that represent a substantial economy by reason of their low cost, measured in terms of long life.

—and in doing these things he reflects credit on his own purchasing ability.

The lineman pattern illustrated here is an outstanding example of the fine design and durable construction that make every pair of Vacuum Grip pliers "a good buy from all angles."

Write for Catalog of complete line and ask us to quote prices on six and more pairs of lineman pliers, in sizes desired.

Made by the FORGED STEEL PRODUCTS CO. Newport, Pa. —and made RIGHT!

Vacuum Grip Pliers

OVER A MILLION AND A QUARTER IN USE

Florida Exchange Installs Dial

Lutz, a small community about 15 miles north of Tampa, and formerly working on a magneto service out of the Tampa all-dial exchange, was cut to an unattended all-relay automatic exchange recently.

The new equipment is housed in what is virtually a cement box, the sidewalls being of cement block and both floor and roof of solid cement. Interesting features in provisions made for air circulation allow air to enter building from the outside, circulate around the equipment room between inner and outer walls—and return to the outside.

Lutz is the third unattended dial sub-exchange installed by the Peninsular company to work out of its Tampa exchange, the other two being Temple Terrace and Port Tampa. Tampa proper is served by four exchanges.

ONLY 15 DAYS LEFT
Subscription Price Advances from $1.00 to $1.50 on October 1, 1940.

W. N. McAnge

W. N. McAnge, Jr.

WILLIAM Norman McAnge Jr., President of the Inter-Mountain Telephone Co., who was one of the most prominent telephone officials in the South, died at his home in Bristol, Va.—Tenn., Aug. 30. Mr. McAnge who was 58 years old had suffered a serious heart attack on Aug. 19 and had been in a critical condition since that time.

Not only a leading telephone official of the South with wide contacts in that industry, including membership on the board of directors of the United States Independent Telephone Association, Mr. McAnge was prominent in civic, state and educational affairs in the Appalachian region of the country. Among the principal posts in civic and state affairs which he had held were the vice presidency of the Virginia State Chamber of Commerce for four years and presidency of the Alumni Association of the Virginia Polytechnic Institute, his alma mater.

A very large number of out-of-town telephone officials—between 50 and 60—attended the funeral services Aug. 31. These included L. B. Wilson, President, Phillip O. Coffin and R. C. McCann, Vice Presidents, of the Chesapeake and Potomac Telephone Co., together with A. L. Lambdin, General Commercial Manager of the C. & P. of Va.; J. G. Bradbury, General Plant Manager, of the Southern Bell Telephone and Telegraph co. of Atlanta and T. B. Baird, Tennessee Manager of the Southern Bell; Albert Parlett, Sales Manager of the Kellogg Switchboard & Supply Co. of Chicago; and R. H. Burfeind of the American Automatic Electric Sales Co. of Chicago. Other telephone officials came from Knoxville, Tenn., Roanoke, Charlottesville, Richmond, Norfolk, Franklin, Va., Tarboro, N. C., Dayton, O., and other points outside the Inter-Mountain Co. territory.

The active pall bearers at the funeral and burial, the latter rite being held at Suffolk, Va., were W. G. Griffin, Vice President, A. U. Meadows, General Plant Manager, C. S. Carter, A. E. Reynolds and M. W. Cox, all of the Inter-Mountain Co.; Mr. Bradbury and Mr. Baird of the Southern Bell and Mr. McCann of the Chesapeake and Potomac Telephone Co. of Virginia. The honorary pall bearers were all members of the Inter-Mountain "Telephone Family."

Mr. McAnge was born in Suffolk, Va., August 1, 1882, the son of William N. and Alein (Riddick) McAnge. After preparatory school education in Philadelphia, and at the University School of Suffolk, Va., he pursued his college course at the Virginia Polytechnic Institute, receiving a B. S. degree in electrical engineering in 1902. He was later prominent in VPI alumni affairs and headed its Alumni Association and Alumni fund campaign.

His first commercial venture was with the Atlantic Coast Telephone Company and the Atlantic Coast Construction Co., in which firms he held the office of Vice-President, remaining with these organizations until 1906. He resigned from these companies to become sales engineer of the Electric Heating and Manufacturing Co., Los Angeles, Cal., But he only remained in this work for two years and returned to the telephone industry becoming general manager of the Jackson, Tenn., Home Telephone Co. in 1908. In 1911 he left the Jackson telephone company to join the Allen Properties, with headquarters in Corinth, Miss, as operating vice president. Then in 1919 he was elected to the offices of President and Treasurer of the Allen Properties.

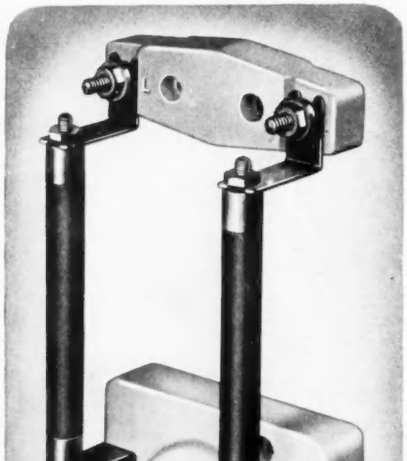
In 1925, Mr. McAnge acquired the controlling interest in the Inter-Mountain Telephone Co., with operating headquarters in Bristol, Tenn. He immediately became president and treasurer of this company, which operates twenty-six exchanges in eleven counties in Southwest Virginia and East Tennessee.

In addition to Mr. McAnge's successful operation of telephone properties, he had always been deeply interested in civic and business affairs, not only in his own community, but on a state and national basis. He was, First Vice-President and a Director of the Dominion National Bank, Bristol, Va., President and Director of the Bristol Theatre

HERE'S A TYPICAL EXAMPLE
On your lines this L-M Steel House Bracket will give you a typical example of the long service life you can expect of all L-M Telephone Construction specialties. Its fine, high-strength steel body is thoroughly galvanized. Its glazed porcelain insulators meet the industry's most exacting standards. Make a note now to try this L-M House Bracket . . . and to get the full facts on the complete line of L-M Pole Line Hardware and L-M Telephone Construction Specialties.
LINE MATERIAL CO.
REPRESENTED BY
AMERICAN AUTOMATIC ELECTRIC SALES CO.

SANDS

SUBSTATION PROTECTOR



TYPE 12
for Indoor Installation

You can get **full** protection with **lower** maintenance costs by installing the SANDS Type 12 Indoor Protector. Its 2105 Discharge Block is self grounding on heavy currents, and automatically resets itself when the current ceases. Eliminates re-setting expense, and —best of all—you're assured of constant, unfailing protection. Put Type 12 at the top of your next supply order.

AUTOMATIC ELECTRIC

AE SP

TELEPHONE, SIGNALING, AND COMMUNICATION APPARATUS

Distributors in U. S. and Possessions:
AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
1033 West Van Buren Street, Chicago, U.S.A.

Corp., Bristol, Tenn., Trustee of Milligan College, Milligan, Tenn., Member of the National Council of Boy Scouts of America, and held Directorships in the First National Bank, Bristol, Tenn., Southwestern Virginia, Inc., Wytheville, Va., and the United States Independent Telephone Association, Chicago. He was also a past President of the Bristol Rotary Club, and served as a Director and Vice-President of the Virginia State Chamber of Commerce for five years, 1935-1939. His club affilations included the Rotary Club of Bristol, Banker's Club of New York City, University Club of Washington, D. C., Franklin Club of Elizabethton, Tenn., Country Clubs of Bristol and Johnson City, Tenn., the Hampton, Va., Yacht Club and the Commonwealth Club of Richmond, Va.

Mr. McAnge was a member of the American Institute of Electrical Engineers, Society of Military Engineers, O D K Honor Society, and the Phi Kappa Phi Honor Society. The telephone company president was active in church affairs, being a life-long member of the Episcopal Church, and a Vestryman in the Emanual Episcopal Church, Bristol, Va.

For hobbies Mr. McAnge was interested in automobiles and boats and had retained a major interest in yachting from his boyhood days. He spent much time fishing and cruising on Chesapeake Bay on his motor cruiser Matoaka III.

His wife, the former Miss Penelope Smith of Suffolk, whom he married Oct. 19, 1906, survives, together with one son Thomas R. McAnge, a sophomore at VPI, his mother Mrs. W. N. McAnge Sr. and a sister Miss Louise McAnge, both of Suffolk.

J. Walter Dietz To Serve Defense Comm.

ANOTHER telephone industry official has been drafted by the National Defense Advisory Commission for expert assistance. He is J. Walter Dietz, Personnel Relations Manager of the Western Electric Co., and will be charged with the assistant directorship of the program of training workers within industry.

The Western Electric official is regarded as one of the leading experts of the country in personnel relations. He has been serving on important governmental advisory groups for the Federal employment service and in aiding the Civil Service Commission upon occupational research problems and improvement of government workers' activities. During the first World War he was on the advisory board of the War Department on education and special training.

Telephone Legionnaires Invited to Boston

Telephone legionnaires from all parts of the county who are planning to attend the National American Legion Convention in Boston, September 22-26, will be able to register at a headquarters for telephone legionnaires which has been provided at 84 Boylston Street, opposite Boston common where visitors are invited to register as soon as they arrive. The visiting telephone Legion members are asked to make it their downtown headquarters for their stay. In addition, the post quarters of Alexander Graham Bell Post in Allsson, a Boston suburb, have been thrown open to visiting telephone legionnaires.

R. A. Hackbusch Becomes General Manager of Stromberg-Carlson's Canadian Branch

Ralph A. Hackbusch, New General Manager of Stromberg-Carlson Telephone Mfg. Co. of Canada, Ltd.

Mr. Ralph A. Hackbusch who since 1930 has been Chief Engineer and Factory Manager of the Stromberg-Carlson Telephone Mfg. Co. of Canada, Ltd., has just been appointed as its General Manager, according to an announcement made by Wesley M. Angle, president of the parent Stromberg-Carlson Telephone Mfg. Co. Mr. Hackbusch succeeds N. W. Baldwin who was called to the firm's home plant in Rochester, N. Y., to be in charge of production of army equipment contracted for with Stromberg-Carlson by the U. S. government in connection with its defense program.

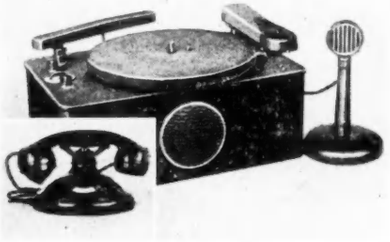
Mr. Hackbusch has been active in radio engineering work for many years and is prominent in radio engineering circles. He has been a director of the I.R.E. and Past Chairman of the Toronto Sec-

tion of the Institute of Radio Engineers. He has been a member of the Rochester Fall Meeting Committee since the inception of that important annual I.R.E. event. He is a Fellow of the I.R.E. and the Radio Club of America, a member of the Joint Co-ordination Committee on Radio Reception of E.E.I.—N.E.M.A.—R.M.A., a member of the General Standards Committee of the American R.M.A., and a member of the Board of Editors of the R.M.A. Engineer. He acted as R.M.A. of Canada from 1931 until 1939. Chairman of the Engineering Division and as Director of Engineering of the and a member of the Board of Directors He is a registered Professional Engineer of the R.M.A. of Canada.

Mr. Hackbusch was born in Hamilton, Canada in 1900 and obtained his early education at the Hamilton Technical and Art School. He became interested in Wireless as early as 1913 and was employed by the Canadian Westinghouse Company in various phases of radio work from 1921 until 1928 when he accepted the position of Associate Radio Engineer of Canadian Brandes, Ltd. In 1930 he joined the Stromberg-Carlson Co. of Canada, Ltd. as Chief Engineer and Factory Manager, which position he held until his recent appointment as General Manager.

Telephone Recorder for Dispatchers

A new low priced telephone recorder is being marketed by the Mellaphone Corporation of Rochester, New York. The Mellaphone Telephone recorder is especially designed for making phonograph records of telephone calls.



It is especially designed for the dispatching of ambulance, police, and fire apparatuses as it double checks the dispatching operator from sending the apparatus to the wrong street. As soon as the call comes in the operator presses the switch which starts the recorder in motion and then he has a complete record of the address and where the call was given from. He may instantly play this back to assure himself of the accuracy of the call.

The records are inexpensive and light and may be filed away as easy as a letter. It is furnished complete with microphone so that other records may be made without the telephone.

New Type Coiled Cord

A newly developed coiled telephone cord has been made available under patents controlled by Colbell Coiled Cords, Santa Monica, California.

Two of the cord's novel features are that no spring or stretched rubber agent is used to gain the retractile action, and it differs from any other retractile cord because it is free from all fatigue stress when in its coiled position which is the fundamental secret of long life.,

The retractile feature is a permanent

A NEW, IMPROVED— UNIQUE FURNACE SPLICERS

Melts 50 Lbs. of Solder in 10 Minutes

Basically the same fine furnace used by larger Utilities for 20 years - Now with

- **FINE FLAME CONTROL**—keeps solder at "just the right temperature."
- **"QUICK CHANGE" GENERATOR**—removed and replaced in 60 seconds.
- **WIND-PROOF**—housing shields generator—No extra shield is needed.

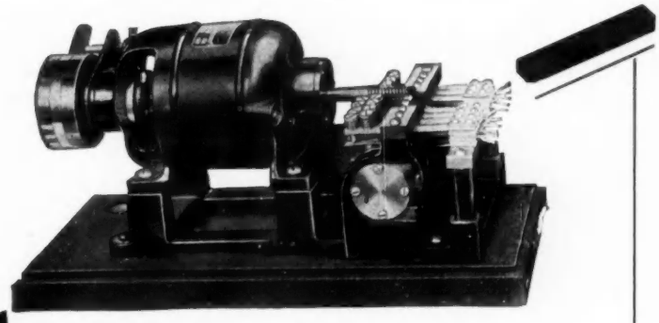
Additional Features: Long-life figure "8" generator—with orifice scraper. Rugged semi-steel top plate. Powerful pump. 16 gauge welded steel tank with bottom shock ring. Size 8" x 13". Weight—15 lbs. Popular size for 6", 7", and 8" pots.

No. 55-I—Kerosene **No. 53-I—Gasoline**

If clear white gasoline is hard to get, order the Kerosene Furnace. You'll like it.

We Invite An Approval Test

UNIQUE MANUFACTURING CO., Inc.
221 W. Walton Street — Chicago, Ill.



HOLTZER-CABOT
MOTOR-DRIVEN INTERRUPTER

Holtzer-Cabot complete motor driven interrupter equipment combines a method of producing good signaling tones with a means for automatic ringing. Holtzer-Cabot interrupter equipment will:

1. Eliminate slow acting relays.
2. Reduce maintenance.
3. Give positive timing.

AND

4. Is SIMPLE AND DEPENDABLE.

Write for Bulletin 1310-02

125 Amory St. BOSTON, MASS. *Motor Specialists* **6161 S. State St. CHICAGO, ILL.**

The Clearing House

For the convenience of readers of Telephone Engineer

Battery Eliminators

THE NEW ELECTROX

Battery Eliminator Type PA-05004

$16.85

Complete with power-off relay. Output for two operators' sets. Mount; connect two leads to operator's terminal; plug in cord. Presto! no more battery problem! Sent on trial. Write for Cir. 373.

ELECTROX 2060-68 Reading Road

A Schauer Product CINCINNATI, OHIO

Tests Sets

FOR SALE

1 New West Test Set used one year.....Price $30.00

1 Stewart Test Set "Heavy Duty Type"..Price $15.00

1 New Teleohm Tester. Price $10.00

Reply, Box 803S
TELEPHONE ENGINEER

Telephone Directories

LOOMIS ADVERTISING CO.

A SALES ORGANIZATION *exclusively..*

That Has Never Failed to Produce More Net Revenue (All Costs Considered) for Telephone Companies Served.

IF INTERESTED in more net telephone directory revenue write or call at our expense.

LOOMIS ADVERTISING CO.

Telephone Bldg., Kansas City, Mo.

Citizens Trust Bldg., Fort Wayne, Ind. 135 So. Second St., Philadelphia, Pa.

part of the cord and is so efficient it may, without damage, be stretched to eight times its coiled length hundreds of thousands of times.

Ray-O-Vac Names Norman D. Vea

The appointment of Norman D. Vea as general sales manager is announced by the Ray-O-Vac Company, Madison, Wisconsin. Mr. Vea has been a member of the sales staff of the company for the past two years, most recently as assistant sales manager.

Vea, although one of the youngest sales executives in the flash-light and battery field, is well known in electrical merchandising. He was recently associated with the Dover Manufacturing Company occupying many positions as plant manager, sales manager and later as president.

The development of compact flashlight and flashlight battery departments for retailers has been one of Mr. Vea's most important studies for the past year.

Storage Battery for Flashlights

A Rechargeable Flashlight Battery similar in principle to the well known automobile storage battery is announced by the Ideal Commutator Dresser Company, 5078 Park Avenue, Sycamore, Illinois.

Although small in size to fit all popular two cell, 1¼" size D flashlight cases, it is proven through actual heavy duty service to be dependable long lived and economical.

A small charger consisting of transformer and rectifier plates makes it easy to keep the battery always fully charged. Merely plug into convenient 110 volt, 60 cycle wall socket. The recommended charging time is 12 hours for which the cost is only about 1/10th of 1c per charge based on a 5c kilowatt hour rate. A clip is also available for charging from a 6 volt automobile battery. For large users a "Gang Charger" can be supplied. For additional information write the company and mention TELEPHONE ENGINEER.

Telephone Directories

Telephone Directory **ADVERTISING**

Write or telephone for proposition

L.M.BERRY & CO.

Call L.D. 16, Telephone Bldg., Dayton, O.

Telephone Engineers

J. G. WRAY & CO.

Telephone Engineers

Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies

105 West Adams Street
CHICAGO

J. W. WOPAT

CONSULTING ENGINEER

Telephone Engineering — Construction Supervision — Appraisals — Financial — Rate Investigations

1510 Lincoln Bank Tower
Fort Wayne, Indiana

Cedar Poles

Carney

CEDAR POLES

Plain or Butt Treated

B. J. CARNEY & CO.

100 No. 7th St. Minneapolis

Finished Cedar Poles

VALENTINE CLARK CORPORATION

St. Paul, Minn.

Wipe Joints

How to—

Wipe Perfect Joints

on lead-sheathed cable splices.

A post card for free instructions

GEO. E. WILLIAMS, Mfr.

811 W. Lake St. Minneapolis, Minn.

The Clearing House

For the convenience of readers of Telephone Engineer

QUALITY CORDS

★ WHEN YOU NEED CORDS ★

★ BUY QUALITY CORDS ★

Commercial cords are high quality cords, because they are made using the best materials and with expert workmanship.

Send for samples and convince yourself that their quality and prices are right.

"QUALITY CORDS"

Commercial Cord

AND SUPPLY COMPANY

CLIFTON SPRINGS, N. Y.

Reconstructed Equipment

Automatic Elec. Co. No. 426 Desk set complete with Trans. Rec. and No. 24 Dial, complete with Molded or No. 500 Enclosed Gong Steel signal sets equipped with Anti Side Tone 3 winding Ind. Coil and straight line Ringers @ $12.00

Auto Elec. Co. No. 21 D. C. Desk stand with Trans. Rec. & Dial, complete with Kellogg No. 404 Straight line steel Bell box @ 8.00

Auto Elec. No. 21 Steel Hotel sets, complete with Dial, Straight line enclosed gong ringers and Anti Side Tone 3 winding Ind. Coil $8.50—D. C. Type @ 7.25

Kellogg No. 700 Masterphone with Kellogg Inside connection 3-bar 1000-1600 or 2500 ohm ringer signal set @ $17.50 —4-bar $18.25—5-bar @ 19.00

W. E. 3 Cell Battery Boxes @ .55

Stromberg Carlson No. 896 Inside connection compacts with Short Arm—3-bar 1000-1600 or 2500 ohm ringer $7.50—4-bar $8.75—5 bar @ 9.50

Kellogg No. 2800 Inside connection compacts with Short Arm 3-bar 1000-1600 or 2500 ohm ringer $8.50—4-bar $9.25 —5-bar @ 10.50

Stromberg Carlson No. 992 Desk set with Connecticut Tel. 3-bar 1000 ohm ringer external post connection signal set @ 8.00

Stromberg Carlson No. 992 Desk set with inside connection 3-bar 1000-1600 or 2500 ohm ringer signal set @ $8.75 —4-bar $9.25—5 bar @ 10.50

REBUILT ELECTRIC EQUIPMENT CO.

1934 WEST 21st STREET

Pilsen Station

CHICAGO, ILL.

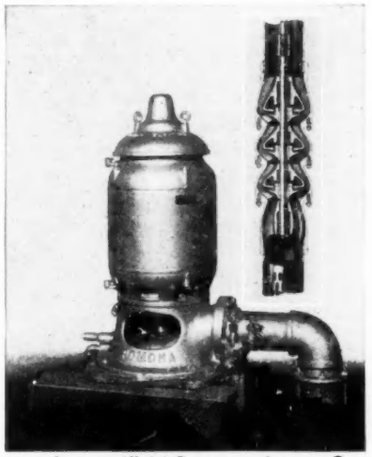
David H. O'Brien Named By Graybar

Effective immediately, according to an announcement by E. A. Hawkins, Vice President in charge of sales, Mr. O'Brien will assume charge of Telephone and Research Products Sales Departments in addition to his former responsibilities as General Merchandising Manager. Under this new setup A. J. Eaves, Assistant General Telephone Sales Manager, and his staff—J. B. Long, Telephone Sales Manager, G. L. Donnett, Research Products Sales Manager, and L. D. Gore, Sales Manager, Hearing Aids Department — will report to Mr. O'Brien.

New Turbine Pump

The Pomona Pump Company, 647 East Commercial St., Pomona, California, announces the complete redesign of its line of 6" medium capacity vertical turbine pumps. As a result of improved engineering practice, particularly in the newly designed impellers and seats, the manufacturer states that the new models afford higher efficiency and better performance, resulting in lower cost for the user.

Other advantages of these pumps, making for extremely low operating costs, lie in the facts that they are water-lubricated, with no stuffing box below

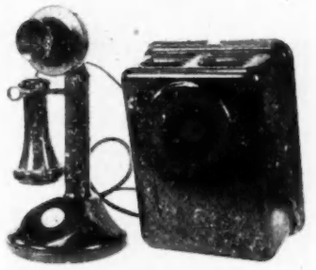


Pomona's new 6" M.C. pump. Insert: Cross section view of pumping stages, showing newly-designed impellers and seats.

ground level; that the specially-designed semi-open impeller can be adjusted from the surface for wear and for changing capacity; and that they are non-sand-locking and non-gaslocking. Write for Bulletin 26, its free, for the asking.

Specialists in Rebuilding and Repairing

TRANSMITTERS



DIAL PHONES REBUILT LIKE NEW

Auto-Elec. Co. Off-center Desk Stands No. 21 arranged and wired for (but less) dials $4.50

Enclosed Gong C. B. Ringer Boxes (Straight Line) for above $4.50

WE WANT TO BUY

Kellogg, W. E. and Stromberg Ringers, Generators, or Complete Telephones, also 4 bar Generators of any make.

Telephone Repair Co.

Daniel H. McNulty, Manager

Rogers Park Station Chicago

RECONDITIONED KEYS

CAM

HARMONIC

PUSH BUTTON

INDIVIDUAL

KELLOGG - WESTERN

S. C. CO. - A. E. CO.

LEICH - MONARCH

DEAN - NORTH

Escutcheons as specified.

Buckeye Telephone & Supply Company

COLUMBUS, OHIO

Crapo
HIGH-TENSILE
LOW-RESISTANCE
LINE WIRE

300-foot Spans of *Crapo* HTL-135 Line Wire in Heavy Loading District

LONGER SPANS
STRONGER SPANS

TELEPHONE companies throughout the country are cutting construction costs, reducing maintenance expense, improving service on rural lines by using *Crapo* HTL-85 and *Crapo* HTL-135 High-Tensile, Low-Resistance Line Wires.

***Crapo* HTL-85 permits spans of 225 feet in heavy loading to 375 feet in light loading districts. *Crapo* HTL-135 makes possible spans of 350 feet in heavy loading to 500 feet in light loading districts.**

Complete technical data and construction practice information will be forwarded on request. Ask for Bulletins No. 201 and No. 202!

For Long Spans

For Extra Long Spans

INDIANA STEEL & WIRE CO.
MUNCIE, INDIANA

Index to Advertisements

A

Acorn Insulated Wire Co. —
American Coach & Body —
American Steel & Wire Co. —
American Tel. & Tel. Co. 8-9
Automatic Electric Co. 26-27-35-36-37-38-39-40-41-42-43-50-54
Automatic Tel. & Elec. Co., Ltd. —

B

Banks Mfg. Company 49
Barnard Co., B. S. —
Bartlett Mfg. Co. —
Berry, L. M. 56
Brach, L. S. Mfg. Co. 52
Buckeye Telephone Supply Co. 57

C

Calculagraph Co. 12
Carney & Company 56
Chance Co., A. B. 34
Channel Splicing Machine —
Coffing Hoist Co. —
Columbia Steel Co. —
Commercial Cord & Supply Co. 57
Communication Equipment & Engineering Co. —
Cook Electric Co. 11
Copperweld Steel Co. 2

D

Davey Tree Expert Co. —
Dillon, W. C & Company —
Dorson Corporation —

E

Electric Storage Battery Co., The 6

F

Fansteel Metallurgical Corp'n. —
Forged Steel Products Co. 52

G

Gardiner Metal Co. —
General Cable Co. 25
General Electric —
Graybar Electric Co. 13

H

Holtzer Cabot Electric Co. 55
Hubbard & Co. —
Hotel Mark Twain 32

I

Independent Tel. Repair Co. —
Indiana Steel & Wire Co. 58

J

Jackson Lumber Co. —

K

Kearney Corp., Jas. R. 51
Kellogg Switchboard & Supply Co. 5

L

Leich Sales Corp. 3
Lenz Electric Mfg. Co. —
Lincoln Hotel 13
Line Material Co. 53
Loomis Advertising Co. 56
Lorain Products Corp. 13

N

National Carbon Co. 14
National Telephone Supply Co. 59
North Electric Mfg. Co. 60

O

Oliver Iron & Steel Corp. —
Owens-Illinois Glass Co. 49

P

Paine Company, The 32
Pearl, Wm. H. —
Phillips Electric Works, Ltd. 12
H. K. Porter, Inc. —

R

Raytheon Mfg. Co. 44-45
Rebuilt Electric Equipment 57
Reliable Electric Co. 48
John A. Roebling's Son 46

S

Seymour Smith & Son 33
Schauer Machine Co. 56
Shallcross Mfg. Co. 47
Sherron Metallic Co. —
Siemens Bros. & Co., Ltd. —
Stromberg-Carlson Tel. Mfg. Co. 7-29
Suttle Equipment Co. 51

T

Telkor, Inc. 52
Telephone Repair Co. 57
Telephone Engineer 4

U

Unique Mfg. Co. 55
Union Carbide & Carbon Co. 14
U. S. Steel Corp. —
U. S. Independent Tel. Assn. —

V

Valentine & Clark Corp. 56

W

Western Electric Co. 31
Williams, Geo. E. 56
Wopat, J. W. 56
Wray, J. G. & Co. 56

LEICH SALES CORPORATION

427 W. RANDOLPH STREET · CHICAGO ILLINOIS · FRANKLIN 2931

DISTRIBUTOR FOR PRODUCTS OF LEICH ELECTRIC CO. GENOA, ILLINOIS

LEICH SERVICE

October 1st
1940

TO ALL INDEPENDENT TELEPHONE MEN:

We take pleasure in extending to you a most cordial invitation to attend the Leich exhibit at the Annual Convention of the United States Independent Telephone Association, Stevens Hotel, October 15, 16, 17 and 18, in

Rooms 2511, 2512, 2513 and 2514.

On display will be an extensive showing of Leich Streamlined Switchboards; Leich PBX's; Leich Handset Telephones; and representative products from Leich's Complete Line of Telephone Construction Materials, Tools and Supplies.

We sincerely believe that a visit to this exhibit will be enlightening as to why telephone men are turning in ever increasing numbers to the Leich Organization for all of their requirements.

The entire Leich executive staff and all Leich field representatives will be on hand to welcome you.

Sincerely yours,

LEICH SALES CORPORATION

R W Siemund

President

RWSiemund;tj

EVERYTHING FOR THE TELEPHONE INDUSTRY